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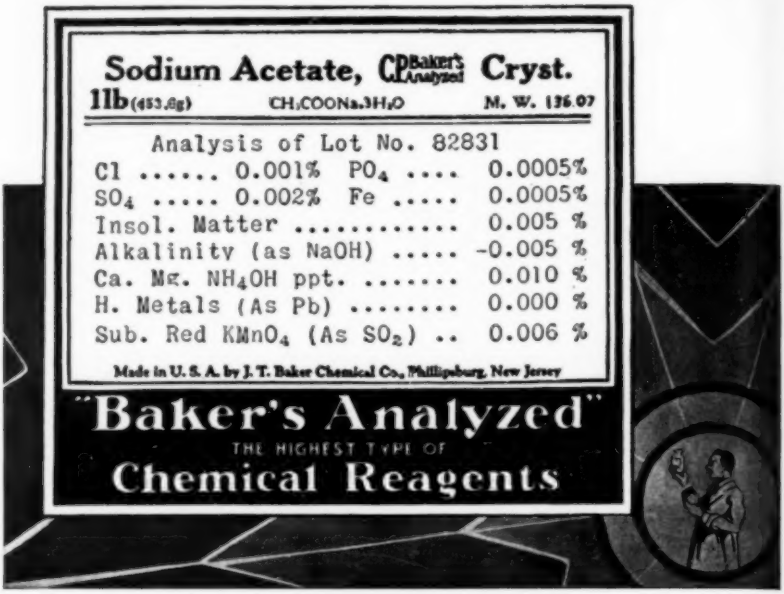
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EDITORIALS

Scientific Honesty

CHEMISTS, more than most people, are expected to be accurate and trustworthy as regards figures. Chemists are supposed to see not what they want to see but what there is to be seen. Figure-juggling is an art which can bring an individual chemist—and with him the entire chemical profession—into disrepute more quickly than anything else.

We are all familiar with the sort of thing that can happen in elementary courses—quantitative checks to six significant figures, large yields of such organic products as can be bought at the corner drug store, other results that, uncritically examined, would indicate a high order of ability on the part of the student.

It is to be hoped that such students are weeded out before they reach the status of practicing chemists. No chemist is of any use to his client, to the world, or eventually to himself, if he does not use scrupulous care in reporting what he actually finds.

Just now the important figures in the chemical profession are unemployment statistics. Here accuracy is particularly necessary. Unemployment figures are so difficult to get and such a hard problem generally that it is easy to stop looking after the total threatens to rise higher than the compiler of the figures would like to have it. It is easy to add qualifying phrases which conceal the real truth, easy to extrapolate re-employment figures and to neglect to extrapolate unemployment figures.

That some of the reports on chemical unemployment are incorrect is clear, since those who are working on this problem report different results. Opinions differ not only between the various organizations but within the same organization. As long as this was the case, it was unfortunate that any figures at all on the subject appeared in so prominent a place as the headlines of *The New York Times*.

There is always a certain amount of psychological justification for those who see what they want to find. Charles Darwin used to make a practice of putting down in a notebook every fact which seemed to refute his theories, knowing that if he trusted to his memory he would forget such adverse facts—honestly forget them.

Whatever the reason for the errors and whoever is at fault, we hope that figures will soon be available showing not only the final result but also the method by which that final result was reached. If the chemical profession is to duplicate the success of the engineering profession in taking care of unemployment, the first requisite is a reliable survey of the problem.

Our regret is that the work has been hampered by estimates so much at variance with each other as to throw the entire project into confusion. We must regret also, from a purely professional viewpoint, any situation in which it is necessary to go behind a chemist's figures to find the real truth.

The Effect on Chemists

THE recent fining of fifteen corporations and individuals for conspiracy to violate the prohibition act brings up an angle of the question which had not occurred to us before, an angle which one chemist described by saying, "If a chemist is in the alcohol game, whether legitimate or not, he's out of luck."

There are a number of ramifications of this question. The outstanding point is, however, that a company which is using alcohol legitimately finds it difficult to compete with a company which is diverting part of its alcohol for beverage purposes. Firms which are selling a portion of their alcohol to bootleggers can afford to give away the legitimate fraction of their product—barbers' supplies, lacquers, whatever the product is.

The industrial result has been (as is pretty evident from reading a list of the fines imposed in Baltimore) that some reputable firms have become guilty of alcohol conspiracy. There are undoubtedly others which have been just as guilty but which have not been caught.

The effect on the individual alcohol chemist has been to give him only two choices, neither very enviable; he can take part in an illegal enterprise, or he can work for a firm that is almost certain to lose money.

We have heard some surprising stories—of companies which tried to be legitimate but were persuaded by government agents to divert part of their product, of ingenious devices for having donations of finished products appear on the books as *bona fide* sales, etc.

Chemists have problems of their own; and the prohibition question is simply one which they share with the entire country. Still, it would be interesting to go into the matter as it applies particularly to chemists. A great many industries use alcohol in one form or another—and every

such industry is affected. The chemists employed in these industries are affected just as vitally.

We will welcome any information which will enable us to prepare an article discussing what is going on. There are always certain difficulties because of the nature of half the story; but we should like to have such material as is available.

Professional Protection

A FEW weeks ago one Domenico Briganti was tried in the court of special sessions, county of New York, under section 1450 of the education law, which provides: "It shall be unlawful for any person to practice or offer to practice professional engineering or land surveying in this state unless such person has been duly licensed under the provisions of this article." A suspended sentence of sixty days imprisonment was handed down after conviction. It is particularly noteworthy that Mr. Briganti is an engineering graduate and that his professional ability was unquestioned.

We have onlv sympathy for the unfortunate Mr. Briganti, but the point of particular interest to the Institute is the great difference between the legal status of the professional engineer and that of the chemist.

For at least two years the Institute has been at work on a licensing law and has had on record its approval of licensing for chemists. Whenever the chemical profession can overcome its inertia it will merit the protection of the professional status that the law affords the united engineering profession.

Process Vendors

By Francis Morlock

The chief chemist of a great chemical company expresses his opinion of an undesirable branch of the chemical profession. An executive's personal reaction.

PUBLIC recognition of the part the chemist plays in shaping the course of modernity is essential to the establishment of the proper status of the profession of chemistry. This recognition is dependent upon both the conduct and the achievements of individual members of the profession. The public measures the chemist by the yardstick he fashions. No group is bigger than its members, and selfish individualism does not help to establish the prestige and extend the usefulness of a profession.

The chemist must work to secure professional solidarity and prestige or be satisfied with obscurity. He must be "qualified by education and experience to ascertain the facts of chemistry and interpret them so as to benefit humanity and accelerate progress." In addition, his professional conduct must always be such as to merit public esteem and justify confidence in his integrity. The professional integrity of the chemist is of paramount importance. His opportunities for service to humanity place him in a privileged position and demand that he recognize the obligations imposed upon him.

In recognizing his obligations to the profession, the chemist must place the good of the profession above temporary personal gain. By so doing he will ultimately gain the status accorded to the members of other great professions. He must realize that his knowledge and experience are the main assets which make him an expert in the interpretation and application of the facts at his command. Like other professional men of high standing, he must use all of his knowledge, experience, and skill without violating confidences previously entrusted to him. It is his obligation to safeguard the interests of his employers as zealously as he would his own, without enslaving himself. This is true regardless of the capacity in which he serves. The ethical principles are the same, whatever his position. His integrity will be measured by his professional conduct.

The status of the chemical profession and the integrity of the chemist are threatened by those who serve as chemists in industry and who are mere process vendors. They are victims of a pernicious custom introduced from abroad, and they are seldom aware of the consequences. They peddle their wares with shameless regularity to interested customers. They come with the collections from here, there, and everywhere, offering to divulge the details of competitors' processes. With his bag of canned knowledge, the process vendor goes from one competing company to another, not being allowed to stay anywhere longer than is necessary to extract the "secrets" and "kinks" from the supposed competitor's processes.

It is amazing, that, on the one hand, the process vendor does not realize the precariousness of his trade, and, on the other hand, that the seeker of information about competitors' processes goes on absorbing, for the most part, useless, out-of-date information, without realizing the asininity of his actions.

The process vendor fails to appreciate his situation. In offering the processes of the Jones and Smith companies, he establishes the fact that he is in possession of property belonging to others; that he is dishonest and should not be trusted. The man who takes Smith's processes to Jones will, if the opportunity offers, collect Jones' processes to offer to Smith. Naturally, Jones is aware of this danger and he tries to safeguard his information. However, both Jones and Smith must realize that in seeking or accepting secret information concerning the processes of their competitors they are forfeiting their right to expect honesty and integrity from those to whom their process information is entrusted.

Of necessity, the process vendor is isolated by Jones or Smith until his special information has been extracted. During this time, the professional process vendor, realizing the fate which awaits him, takes every opportunity to collect all the information that he can get about his employer's processes. He assembles the scraps of information obtained from Jones' plant, producing something which he offers to Smith as the actual processes employed by Jones and with which he has had actual experience. As a rule, the buyer gets nothing of value, but the credulity of human nature is such that both Jones and Smith discount their past experiences and continue to deal with the process vendor, believing that they are learning one another's secrets.

IN PARTICULAR, the process vendors who secured their information abroad have preferential treatment from the chemical industry. They are received with ceremony, handled with deference, paid hand-

somely, and treated with the respect due authorities, until their bags of processes fail to produce the magical results expected. Then they are unceremoniously dismissed.

Gradually, experience is teaching Jones and Smith that the kind of technological information essential for permanent success in the chemical industry can be secured but rarely, if ever, from the process vendor—not excepting the foreign vendor, who claims to have the accumulated knowledge of the chemical world in his possession.

Unfortunately, the process vendor and the chemist are synonymous to many. This is the result of two factors. In the first place, the process vendor usually operates under the title of chemist. Often, he is a capable chemist. More often, he is a mere dealer in chemical processes with little or no chemical training and experience, and is untroubled by conscience and unhampered by principle.

Such a dealer is a double menace to the profession of chemistry. By representing himself as a chemist, he associates the practice of taking and selling processes with the chemist, establishing a false conception of the honesty and integrity of the chemical profession. By his high-power salesmanship methods, he is able to sell worthless processes, as he would other gold bricks, with the usual disastrous results that follow the recognition of the fraudulent nature of such transactions.

In the second place, the legitimate chemist, in seeking a position, thinks it necessary to relate what he knows to create interest in his capacity to serve. This places him in the class of the process vendor who is willing to barter his past experience for a job and subjects the chemist to a degrading inquisition which embitters his spirit, involves his honor and integrity, endangers his future, and compromises his profession.

IF he secures a position after the "third degree" method has established his fitness, the chemist finds that he is expected to continue to give up information until he is squeezed dry, when he is apt to find that he is no longer needed—or, if he is retained, he is not trusted with all the information essential to a thorough understanding of the problems to the solution of which he contributes. The chemist may fail to obtain the position, but, in the effort to demonstrate his fitness, he often gives valuable information to his interviewers.

In any event, the willingness to tell what he knows to impress the prospective employer with his fitness to serve, makes him a vendor of information instead of an expert, whose knowledge and professional standing alone should be sufficient to establish confidence in his capacity for service in chemistry.

THE chemist must recognize the degree to which he is responsible for this situation; and he must resolve to adopt a new professional policy. He must seek positions not as an individual in possession of process information, but as an expert who has the backing of his professional organization. The chemist must awake to the realization that he is a member of a dignified profession and that whatever he does reflects on the profession as a whole, enhancing or diminishing its prestige. He must become conscious of his obligations to uphold the honor and dignity of the profession. He must cooperate with other members of his profession to help his professional organization, The American Institute of Chemists, to secure for the profession a status which places the individual members of the profession above the necessity of trading process information for a job.

When the chemist assumes the proper professional attitude, he will not be required to deliver the processes of his former employer before being assured of employment. His ability to serve industry will not be measured by the importance of the information he gives about competitors' processes and efficiencies, but will be evaluated in terms of his demonstrated honesty, ability, integrity, and proficiency.

The chemist must, in addition, help to put the process vendor out of business. This he can do best by pointing out to the chemical industry that no good comes of the practice of collecting information from process vendors. It would be far better for the chemical concerns to agree to exchange process information. This would save the money they now pay to secure the information and to verify the results. Besides, they would then know that they had correct information and they would avoid duplication of effort, which is costly and unnecessary. Smith and Jones will get the essentials of one another's processes anyhow, and they gain nothing by securing the information fron itinerant process vendors. When there are no buyers of processes, there will be no vendors of processes.

THE chemist will do much toward raising the status of his profession and putting the process vendor out of business by assuming a proper attitude toward his profession, refusing to take or to give information which he has been paid to secure for his employer. He must recognize the difference between the ethics involved in disclosing to Jones the confidential, special information secured at Smith's expense and the principles which make him render loyal, efficient, honest service in Jones' employ without betraying the confidences entrusted to him when he was employed by Smith.

We cannot admit that the chemist is not free to go from Smith to Jones because they are competitors. To restrict his freedom of action is equivalent to enslaving him; and no social or legal barriers should interfere with the chemist's privilege to earn his living as a free individual. He must be free to choose to serve where he can render best service, where the opportunities are greatest for his advancement and for the fullest development of his capacities.

THERE seems to be no good reason for depriving the chemist of the privileges enjoyed by other professional men. The physician is not required to furnish Mrs. Jones a detailed report of his successful operation upon Mrs. Smith to establish proof of his skill in surgery. He is not expected to furnish each new patient with a statement of his education and experience. In general, the sign outside his door indicating that the profession of medicine has placed its seal of approval on him is sufficient to invite the average person to submit to examination and to accept the verdict without question.

The lawyer doesn't submit a brief of the case which he regards as a precedent for the new client's case in order to demonstrate his ability to handle the case. He is not considered unethical if he uses all of his knowledge and experience in the preparation of the new case, even if much of his information was paid for by his last client, who is now the defendant in the present case. Each new case requires the best he can bring to bear on it and may involve all of his previous knowledge. No one expects him to furnish a complete record of his achievements. The fact that he is a member of the bar is enough to give him a chance to demonstrate his ability to serve his client.

Is there any reason why the chemist should be singled out for special treatment? He is a professional man and he should expect that his membership in the professional organization of chemists, The American Institute of Chemists, will be a sufficient guarantee of his preparedness for service in chemistry. This should be sufficient to establish confidence in his integrity as a professional man.

The chemist must be judged by his professional conduct. If he wishes to enjoy the privileges of a professional man of distinction, he must take himself out of the class of process vendors.

Economic Prospects of the Medical Chemist

By John M. Ort

A chemist of the famous Mayo Clinic outlines the possibilities of adequate financial return to chemists who assist the work of the physician.

"THE true use of chemistry is not to make gold but to prepare medicine."

In these often-quoted words, Paracelsus, four hundred years ago, gave expression to the dreams and ideals of a great many of his fellow chemists, both ancient and modern. Nothing can appeal more vividly to any student of nature than the hope that by his scientific efforts he may contribute some discovery which will ease the pain of fellow creatures or restore to health and vigor those stricken by disease. The modern biochemist has had enough of such triumphs to encourage him to pursue to the fullest possible extent his studies in those branches of his field wherein little is as yet known.

The purpose of this paper is, however, not to recount these achievements, great as they are, nor to suggest where future advances are likely to be made, but to consider the human side of the organizations in which the biochemist works, and the financial rewards that he receives for his labors. It is an effort to balance, according to the suggestions of Dr. Morgan in the December, 1931, CHEMIST, the extent of his necessary training and ability as a chemist against the nature of his work and his economic prospects, should he devote his efforts to the service of medicine.

In biology as nowhere else is it obviously true that there is no sharp division between chemistry and physics. Given the often-repeated

statement that living organisms are composed largely of colloidal material, it becomes apparent that physical structures and forces are just as decisive as those that are chemical in determining vital processes. The biochemist must therefore have a sound general knowledge of physical principles, for his work will often take on as much of the nature of biophysics as of pure biochemistry. This economic analysis will thus apply with equal force to the biophysicist and the biochemist, although according to their official designation there are as yet considerably fewer of the former.

The chemist in the medical field will probably work either in what may be called a control laboratory or in research. As is usual with arbitrary divisions, these fields may, in the case of a given individual, considerably overlap.

Of course, a great number of biochemists of all grades and classes are employed by schools and universities for teaching and research work of all kinds. These chemists are of all ranks, from laboratory assistants to professors in charge of departments. The economic rewards of this group need not be considered in detail in this paper, since it is safe to assume that the average reader of *The* CHEMIST is fairly familiar with the qualifications, duties, and salaries of university employees in general. Consideration will be confined to those working for clinics, hospitals, research foundations, commercial laboratories, or manufacturers, or, in general, to all institutions where the university connection, if any, is not the controlling influence governing duties, salaries, and promotions. Such institutions may be operated by individuals, societies, organizations, or branches of the state and federal governments.

The Control Laboratory

In the control laboratory, the chemist practices what is usually termed clinical chemistry. His tests and analyses will aid the physician and surgeon in the routine of the diagnosis, prognosis, and treatment of patients and in the preparation of reports of necropsy. Chemical analyses and tests must be made of blood, urine, and feces, and on a great variety of tissues, fluids, and exudates of the body. These analyses are often complicated, and are made difficult by the fact that the substance to be determined exists only in traces and is in the presence of other material which greatly interferes with the ordinary analytic procedure. Special solutions and medicinal preparations must be prepared, standardized, and kept sterilized. The qualifications for the director of such a laboratory are at least those of an expert analytical chemist.

FIGURE 1.—PART OF THE LABORATORY FOR CLINICAL CHEMISTRY IN THE MAYO CLINIC

He may be assisted in the less difficult routine of the work by chemists much less highly trained, possessing, for example, a bachelor's degree only. The salary for such assistants will vary ordinarily anywhere from $75 to $150 per month. Without further training, the possibility of much further increase in salary, or of promotion to higher rank, is usually nonexistent. There is a growing tendency to employ women in these positions, or men who wish only temporary jobs in which they may obtain experience which will be of value in later, more advanced research or medical work.

In discussing the higher grade of workers in the medical control laboratory, the laboratory's entire purpose must be considered. Material which is subjected to chemical analysis often must be examined microscopically from the bacteriologic or histopathologic standpoint. Examination of the latter type will disclose whether or not changes in structure have taken place. Such findings are in many conditions more significant than the results of chemical analysis. The latter may not markedly differ from the normal.

Obviously, a strictly chemical training cannot qualify one to appreciate the value of such data. Since collection of the material involves contact with the patient, and interpretation of all the results demands a considerable knowledge in bacteriology, physiology, anatomy, and

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In discussing the higher grade of workers in the medical control laboratory, the laboratory's entire purpose must be considered. Material which is subjected to chemical analysis often must be examined microscopically from the bacteriologic or histopathologic standpoint. Examination of the latter type will disclose whether or not changes in structure have taken place. Such findings are in many conditions more significant than the results of chemical analysis. The latter may not markedly differ from the normal.

Obviously, a strictly chemical training cannot qualify one to appreciate the value of such data. Since collection of the material involves contact with the patient, and interpretation of all the results demands a considerable knowledge in bacteriology, physiology, anatomy, and

pathology, as well as in chemistry, the growing tendency is to put such laboratories in charge of licensed physicians who are especially well trained in these basic sciences. The steps are but short between examining the patients, collecting the material for analysis, interpreting the results, and directing the subsequent treatment, especially when certain drugs, serums, and so forth are used, the effects of which must be constantly controlled by laboratory findings. The director of such a laboratory is constantly called on to perform what is tantamount to the practice of medicine, which if he is not medically trained, amounts to evasion of the various laws requiring a license for such practice.

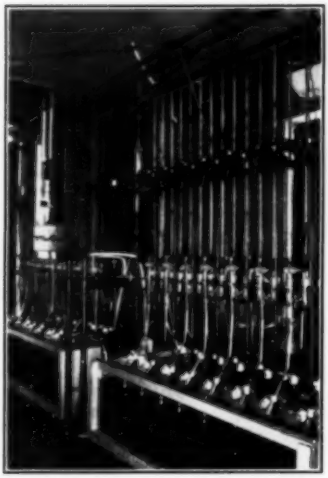


FIGURE 2.—APPARATUS USED BY THE AUTHOR FOR STUDYING THE OXIDATION OF SUGARS

The salary of such a director corresponds fairly well with that of a full professor in a university. Often he may add to this by accepting similar work from practicing physicians and surgeons outside of his own particular organization, men who may not be able to maintain such a laboratory for themselves. If the organization is large enough, he may be required to devote his entire time and that of the laboratory personnel to the organization alone. In this case his salary is somewhat higher, say from $8000 to $12,000.

Commercial Medical Laboratories

There are also a number of commercial laboratories of this nature which are operated entirely as a business venture. Some are headed by non-medically trained chemists and some by licensed physicians. They serve those physicians who are in practice for themselves and who need the usual laboratory data in their practice, but who have neither time nor facilities of their own. Employees of such laboratories will in general have salaries similar to those doing the same kind of work in other institutions. The financial rewards of the proprietors depend as much on their business acumen as on their abilities as chemists. Accurate data on this point are naturally not available.

The non-medically trained chemist in the medical control laboratory, who, while not the director of the entire laboratory, may have charge of certain divisions of the work, will receive a salary anywhere from $2000 to $7000, depending on his qualifications and the size of the laboratory. Some such men are in full charge of their laboratories. Their salaries are usually somewhat less than that of a medically trained director and, as said before, the tendency of the medical profession is to discourage such practice. Figure 1 represents part of a typical medical control laboratory.

For the assistants in these laboratories, that is, those who do the less difficult routine analyses and tests, there is a growing tendency to employ women who have had a more or less special university training in what is called medical technology. They have studied the elements of bacteriology, histology, hematology, and so forth, as well as of chemistry. For this study they receive the usual bachelor's degree. With this training and some experience their salary will in time fall within a range of $150 to $200 per month. Without more advanced training their hope of promotion to higher rank is slight.

Such a laboratory and personnel may also devote considerable time to clinical research. New discoveries must be tried out and the subsequent course of the diseases followed closely by laboratory tests. Or the relation between disease and the chemical changes it entails may be studied in the laboratory in the hope of finding the nature and cause of the disease and, if possible, a cure therefor. In either case, the procedure, as far as the laboratory and personnel is concerned, is but little different from that of a control laboratory.

The Research Laboratory

There remains the great group of biochemical workers engaged primarily or entirely in research. Their contact with the patient usually comes only after their laboratory findings in pure chemistry or from animal experimentation suggest something of value to the patient. The heads of laboratories devoted to this purpose are usually highly trained, though not medically trained, chemists. The salary corresponds to that of a head of a department in our leading universities and for the exceptional man in the larger institutions will probably be from $8000 to $12,000. Where the research partakes more of the nature of physiology or of clinical chemistry than of pure chemistry, the director is often a physician or surgeon, with some considerable ability in chemistry. His salary will be in approximately the same range as the non-medically trained man if his work is confined entirely to research.

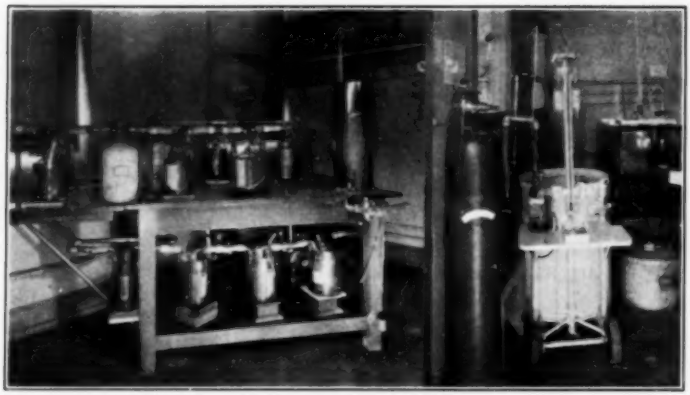


FIGURE 3.—APPARATUS USED IN THE MAYO FOUNDATION FOR STUDYING THE METABOLISM OF DOGS

These laboratories have trained technicians, some of them chemists, with training and salaries corresponding to those in a medical control laboratory. The larger institutions also have the in-between grades of somewhat more highly trained workers, with salaries likewise corresponding to those in similar grades in the control laboratories that have been considered.

Special Conditions for Medical Chemistry

Research work of this nature calls for all the ordinary skill of the chemical investigator in any line. In addition, the biological worker must continually remember that catalysts and physical conditions *in vivo* may so modify the reaction in the test tube that it is hardly recognizable. These factors are numerous, and for the most part, unknown. Generally speaking, the difference between the test tube and living processes are even greater, both in degree and apparent nature, than the well-recognized difference that exists in many cases between reactions in the test tube and economical plant scale production in the industrial world.

The three common divisions of attack in such biochemical research may be represented by Figures 2, 3, and 4. Figure 2 represents an apparatus designed to study *in vitro* the oxidation of sugars by mild oxidants at biological hydrogen-ion concentrations. Figure 3 represents an apparatus by which can be studied the metabolism of dogs, which involves among other things the biological oxidation of sugars, and

Figure 4 represents an arrangement for studying the metabolic rate of man. In all three branches the intricacy of the apparatus, the technical skill required to operate it, and the broad general knowledge necessary to understand and interpret the data so obtained, are all at least the equal of those required in any other branch of chemical research.

Varied Training Necessary

Thus it is seen that the chemist in medicine, whatever his rank, must first of all have at least the full chemical training of the chemist of equal rank in any other field. In addition he must have a wide knowledge of general biology if he is to have any standing at all in his profession; and to reach the top in many branches of his profession he must also have a complete medical training. That is, he should be a fully qualified physician as well as a competent chemist.

These demands exceed those for either a chemist or a physician. The economic rewards do not as a rule exceed those for either the chemist in other fields or for the physician. If he uses the chemical training and ability merely as an aid to his practice of medicine, however valuable this may be, he classifies both professionally and economically as a physician, and as such does not come under the scope of this article. If his main application of his chemical knowledge is in the scientific aspects of medical problems, he may still be classified as a physician, although his financial remuneration may be below that of an equally intelligent and able man functioning as a practicing physician or as a surgeon in charge of patients. The non-medically trained chemist or physicist working in medical laboratories will usually have still less rosy economic prospects.

Advantages of Medical Work

The well-trained chemist working in the service of medicine, whether or not medically trained, has certain advantages. He is not responsible for the life or death of patients. He usually has fairly regular hours of work, or if the hours become irregular at times they are usually under his control and can be provided for ahead of time. He has an intensely interesting and stimulating work. His position is usually more secure and his salary less subject to fluctuations due to times of business depression and prosperity than that of the industrial worker. If his economic rewards be somewhat less than those of topnotch industrial men, he is also freed from the constant economic pressure to produce a money-making product. If there is no yardstick with which to measure

FIGURE 4.—A PORTION OF THE METABOLIC LABORATORY OF THE MAYO CLINIC

his work, as is often the case in research, it should be at least as easy to win the praise of his employer as to incur his wrath.

Other things being equal as to training, ability, and professional standing, the chemist in the service of medicine, as compared with the chemist in industry, receives of the two classes of reward received by all scientific men, somewhat less money and perhaps somewhat more of joy in his work. Therefore, in contemplating entering this field one should, so to speak, psychoanalyze oneself. If a man knows that he has the type of mind to which the second class of reward is particularly appealing, and he knows that he has a strong interest in the chemistry of living things, then he may enter the field with confidence.

Training the Chemical Engineer at Princeton

By Joseph C. Elgin

A chemical engineering curriculum which was established recently enough to profit by the experience of other institutions. The up-to-date ideas in this branch of chemical education.

OPINIONS on the subject of a proper training for the chemical engineering profession are more varied than perhaps for any other field of engineering. This variety finds expression in the heterogeneity of chemical engineering curricula and in the variety of opinions held by chemical engineers in industry, by those intimately associated with the profession, and by chemical engineering teachers.

Such variety is not surprising, in view of the recentness with which chemical engineering has been recognized as a distinct profession. Its rapid development has caused a lack of understanding of the functions of chemical engineering on the part of educators, other engineers, and pure scientists. The variety of industries in which the chemical engineer finds employment and the numerous duties which he is required to perform are also contributory causes.

Chemical engineers and teachers of chemical engineering subjects have different ideas as to what chemical engineering should embrace. The author has recently heard a chemical engineer connected with a large chemical industry express the opinion that entirely too much emphasis is placed on mathematics in the average chemical engineering curriculum—and that the average chemical engineer finds little need in practice for the mathematics given. Nor is this an isolated case.

The author completely disagrees with this opinion, but it is readily seen that it may arise due to a lack of understanding of fundamental

chemical engineering theory and its limitations. The state of development of chemical engineering theory does not, in many cases, permit universal rigid quantitative application, and undoubtedly there are many chemical industries and operations the complexity of which renders mathematical treatment difficult. Nor is there any doubt that in many industries the operations with which the chemical engineer deals do not require extended mathematical knowledge. This, however, does not imply that a thorough training in mathematics is not in general essential for the chemical engineer, nor that it is impossible eventually to treat these operations quantitatively.

Administrative Difficulties

Many of the difficulties encountered in the development of a proper chemical engineering curriculum, among other local factors, are due to a lack of appreciation of the needs of chemical engineering on the part of administrative authorities. The distinction between industrial chemistry and chemical engineering is also often not appreciated. While industrial chemistry is embraced by chemical engineering it is by no means the entire field.

Much progress has been made toward developing the realization that chemical engineering is something more than a mere heterogeneous mixture of mechanical engineering and chemistry; and substantial agreement has been reached on the broad fundamental requirements for chemical engineering training. Concurrence in the viewpoint that such training centers around the so-called basic chemical engineering operations is practically unanimous. Detail examination of various chemical engineering curricula would probably show that these are not so dissimilar as would appear from a cursory glance at the titles of the courses offered. The points of difference are for the most part involved in the extent and advancement of material, point of emphasis, detail, and method of presentation.

Standardization Undesirable

It is felt that the complete standardization of training in engineering, particularly chemical engineering, is neither feasible nor desirable. While certain fundamentals are necessarily the same, the type of training offered will be primarily determined by factors such as location and character of the institution, the size of the engineering school and its relation to the remainder of the institution, relation to chemical industries, and, perhaps of first importance, the type of student, his

previous training and probable future needs. There is a definite need in industry for chemical engineers with different types of training, background, and viewpoint, aside from the question of specialization in a particular branch of the field.

An organized chemical engineering curriculum at Princeton is of comparatively recent date, having been first instituted in 1922. It underwent considerable revision in 1929 and has been developed along certain well-defined lines. The enrolment has been relatively small until the past few years, but numbers 75 students in all five years at the present time. Late entry into the field proved beneficial, since the experience of other institutions, freely put at our disposal, and the results of investigations into chemical engineering education by professional societies could be utilized and fitted into the development of the chemical engineering curriculum, as far as was consistent with the general plan at Princeton.

The curriculum, however, has not reached a stage of definite crystallization but undergoes such revision from time to time as conditions warrant and permit.

Separate Department

Chemical engineering at Princeton is administered as a distinct department of the School of Engineering, in close cooperation with the department of chemistry. The curriculum is based on a four-year course, upon the satisfactory completion of which the degree of Bachelor of Science in Chemical Engineering is conferred, and a fifth or graduate year, at the end of which, in uniformity with the other engineering departments, the degree of Chemical Engineer is awarded.

No further graduate work in engineering is offered at the present time. If the inclination and ability of the student justify it, he is encouraged at the end of the fourth or fifth year, to pursue graduate work in another institution offering suitable advanced work in chemical engineering; or, he can enter the graduate school of chemistry.

The student is admitted to the School of Engineering upon satisfactorily sustaining the College Entrance Board examinations, the subjects demanded differing slightly from those required for the other departments of the University. The Engineering School is limited to an enrolment of approximately 400 in all branches, and the department of chemical engineering will be limited to a maximum of approximately 100 in all five years.

An essential idea in the foundation of the organized School of Engineering at Princeton in 1921 was the combination of an education in

GENERAL LABORATORY FOR ANALYTICAL CHEMISTRY

fundamental engineering and science with a broad liberal education, rather than the provision of a narrow technical education. It was felt that this ideal could be attained by close association of strong departments of liberal studies and of the pure sciences with a school of engineering. In the words of the catalogue, the School of Engineering is designed to serve the needs of three kinds of students:

"(1) Those, who, on completion in four years of a college course divided nearly equally between liberal studies and the fundamental engineering subjects, wish to enter at once upon engineering work. It is believed that this offers a better preparation for the careers such students have in mind than does a four-year course more purely technical.

"(2) Those who intend, upon graduation, to enter one of the many fields of modern industry or business in which success depends so largely upon a fundamentally sound and liberal education coupled with training in basic engineering principles.

"(3) Those who wish to begin work adequately equipped in one particular branch of engineering. These men are able, by the opportunities for elective specialization afforded in the plan, to obtain the professional or technical degree after one year or at most two years of graduate study."

In concurrence with these objectives the chemical engineering curriculum is planned to combine a broad cultural foundation and training

in mathematics, physics, and chemistry with a strong foundation in basic engineering subjects and specialized training in fundamental chemical engineering. This idea is maintained in the selection of the courses and in the method of presentation. There is no attempt to offer specialized technical courses in the several subordinate branches of chemical engineering, such as gas and fuel or metallurgical engineering, nor is there any specialization in particular chemical industries.

The inclusion of liberal subjects and the humanities necessitates the omission of a few of the narrower and more pronounced technical engineering subjects from the four-year course of study. It is not believed that this entails an appreciable sacrifice in the student's knowledge of or ability to apply fundamental engineering and chemical engineering principles. "In all engineering courses the underlying purpose is to teach fundamental principles, with so much of the technique as may be necessary to develop the ability to apply these principles and to illustrate the engineering methods."

In all cases quantitative applications are stressed. There are very few entirely descriptive courses, and these only where this is inherent in the subject. In the fifth year an opportunity is provided to take certain of those technical subjects omitted in the four-year plan, to take advanced courses in chemical engineering and chemistry, and to do independent and research work. There is still no attempt to provide training in any of the specialized branches or in particular industries. Cultural subjects are not included in the fifth year.

Physical Chemistry as the Basis

The curriculum is based particularly on strong courses in chemistry, especially physical chemistry, which is regarded as the basis upon which chemical engineering rests. An adequate knowledge of quantitative physical chemistry is deemed necessary for a satisfactory understanding of the principles and applications of the basic chemical engineering operations. Although these possess their own basic theory and technique, they rest upon applied physical chemistry; and a principal objective at Princeton is to provide the chemical engineer with a basic knowledge of theoretical and applied chemistry supplementing fundamental chemical engineering. The chemical engineering attitude of mind toward these subjects rather than the chemical is developed, but the tendency is to stress the chemical side of chemical engineering rather than the mechanical engineering side.

The writer has recently heard the opinion expressed that all so-

called cultural subjects might well be eliminated from a chemical engineering curriculum. This statement was based upon the viewpoint that a "cultured" engineer cannot be made by the inclusion of a cultural course or so in the curriculum, and that the limited time available was much better devoted entirely to the essential underlying sciences and to the technical engineering and professional chemical engineering subjects.

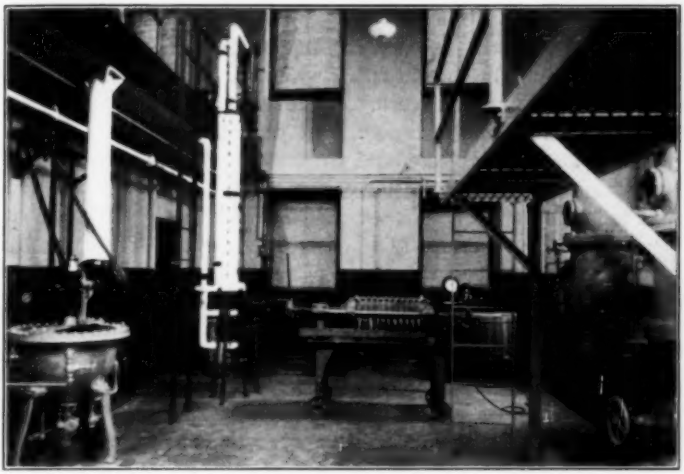
This point of view avoids the issue, as it may equally be said that a chemical engineer is not made by subjecting the student to a few courses in chemical engineering. While the above argument may conceivably hold in some cases, we do not agree in general with the thought behind it. The essential idea at Princeton is not simply the haphazard inclusion of a cultural course or so in an otherwise narrow technical curriculum. There is no thought of producing a completely "cultured" engineer. The endeavor is to aid the student in obtaining a depth of vision and imagination, a personal development, and an understanding of values and of problems in other fields—together with their relation to chemical engineering—which will serve as a basis for further specialized chemical engineering training or for the business or administrative side of modern chemical industry.

It is not believed that this is accomplished by a narrow, purely technical training. The entire curriculum as regards kind of subjects included and the method of presentation is designed to meet this end. There is no mere random inclusion of one or two cultural courses. It is believed that professional courses may be designed to carry out our idea with very little if any sacrifice in their technical or professional engineering value.

Distribution of Courses

The distribution of time in the chemical engineering curriculum is approximately as follows: liberal and cultural subjects, including English, economics, modern language, written and oral composition, and engineering administration, 24%; physics and mechanics, 11%; mathematics, including advanced algebra, spherical trigonometry, coördinate geometry and calculus, 10%; chemistry, 25%; chemical engineering, including thermodynamics, 14%; other engineering, 17%. These figures are based on a total of 160 credit hours, one lecture or recitation per week for one semester being one credit hour, with three hours of laboratory, problem, or applied work equivalent to one credit hour.

The freshman year is the same for all branches of engineering, with the exception that the chemical engineers are required to take German



CHEMICAL ENGINEERING LABORATORY, SHOWING UNIT PROCESS EQUIPMENT

as the modern language. All freshman engineers are given a two-hour course under the title of Industrial Development, which serves to acquaint them with the problems encountered in the engineering field and to orient them in their chosen profession. The majority of the liberal and cultural courses are included in the first two years, as are also the fundamental sciences, such as physics, mathematics, and mechanics. The more technical and professional courses are for the most part given in the junior and senior years.

A three-hour course in the elements of economics is required in the sophomore year, and a three-hour elective in economics in each semester of the junior year. The chemical engineers may elect such courses as Labor Problems, Public Finance, Transportation, Money and Banking, and others. They take the regular courses in these subjects, as the purpose motivating their inclusion is deemed to be better carried out in this way than through especially designed courses for engineers. There is no special course in chemical engineering economics, but, based on these fundamentals, economic factors are considered in several of the chemical engineering subjects.

A short course in engineering administration, which considers such topics as factory organization, wages and wage systems, and contracts and specifications, is required in the second semester of the senior year. A full year of English is given in the freshman year and a two-hour

semester course in written and oral composition in the senior year. The latter is especially designed for engineering students. Chemical engineers are required to prepare their written and oral reports on topics in the field of chemical engineering. The aim is to develop proficiency both in preparing written reports and presenting orally reports on chemical engineering subjects, and to give the student self-confidence and assurance. In each semester of the sophomore year a three-hour elective course is included. The election of a humanistic subject such as history, politics, or philosophy is encouraged, but a science such as astronomy, biology, or geology may be permitted.

There are three four-hour courses in general chemistry, differing in degree of advancement, any one of which the chemical engineering student may take. If he has offered chemistry for admission with a reasonably high standing he may enter one of the advanced courses, the most advanced being reserved for those of very high standing. Both of these include qualitative analysis, a portion of the lectures and most of the laboratory being devoted to this subject.

An average of one and a half of the lecture hours in the general chemistry courses is devoted to preceptorial instruction, the class being divided into small groups of approximately twenty students for this purpose. Those students contemplating chemical engineering are collected together, and this group is conducted by a member of the chemical engineering department. The material considered is the same as for the other students, but the student is acquainted with the chemical engineering aspect and viewpoint. Relation of the subjects studied to chemical engineering and chemical industry is pointed out.

General Requirements in Chemistry

The normal requirement in chemistry for students entering without it, or with a relatively low standing, is the year of general chemistry; two semesters, three hours each, of qualitative analysis in the sophomore year; one semester, four hours, of quantitative analysis, and two semesters, five hours each, of organic chemistry in the junior year; and physical chemistry, four hours each semester, in the senior year.

If the student takes one of the advanced courses in general chemistry the first year, he receives credit for qualitative analysis and may take organic chemistry the sophomore year, physical chemistry the junior year, and may complete his schedule in the senior year by electing an advanced course in chemistry, or in chemical or other engineering

There are no special courses in chemistry particularly for chemical

engineers. They take the regular courses in pure chemistry given in the department of chemistry and taught by the faculty in pure chemistry. The chemical engineers receive essentially the same training in chemistry as those students majoring in pure chemistry.

Chemical Engineering Courses Begin in Junior Year

The first entirely professional chemical engineering course is given in the junior year under the title of "industrial chemistry"* and consists of three hours of lecture or recitation and six hours of problem and applied work per week. A brief survey of the chemical engineering industries, an introduction to the literature of chemical engineering and industrial chemistry, and a general discussion of chemical engineering equipment and methods, engineering construction materials, and their chemical and physical properties are given at the beginning of the course.

General principles underlying all industrial processes, such as chemical engineering units, heat quantities, material and heat balances, equilibrium and rate relationships and their application to industrial chemical processes are then studied. Fuels and combustion and a study of the inorganic chemical industries and processes comprise the remainder of the course, the latter occupying about three-fifths of the time. The problem work is devoted to combustion calculations, the use and applications of material and heat balances, equilibrium calculations, and the solution of quantitative problems involved in the industries studied.

This course is followed by a three-hour course in the first semester of the senior year devoted to the technology of the important organic chemical industries. Both are presented entirely from the chemical engineering viewpoint. No attempt is made to cover all chemical industries, but rather to study the fundamentals of the more important. Those lacking a chemical engineering background are omitted or considered very briefly.

Work Out Industrial Problem in Laboratory

An industrial chemistry laboratory course consisting of one conference and five hours of laboratory for one semester is given in the senior year. A problem involving a suitable industrial chemical manufacturing

* There seems to be some disagreement as to just what is implied by "industrial chemistry," and confusion as to what it consists of. There is a tendency among chemical engineering teachers to avoid its use in describing chemical engineering courses, which probably arises from the effort to get away from the older conception of industrial chemistry. It seems to offer, however, a satisfactory generally descriptive title.

process is assigned and the student is required to make a preliminary investigation of the chemistry, raw materials, and products involved, plan and carry out the process quantitatively in the laboratory on as large a scale as is feasible—taking all data necessary to make a preliminary flow sheet, design the necessary plant and equipment, and make a calculation of quantities of materials to be handled, with costs and estimate of economic feasibility. Elements of process development, plant design and location, choice of equipment, and economic questions are discussed in the conferences.

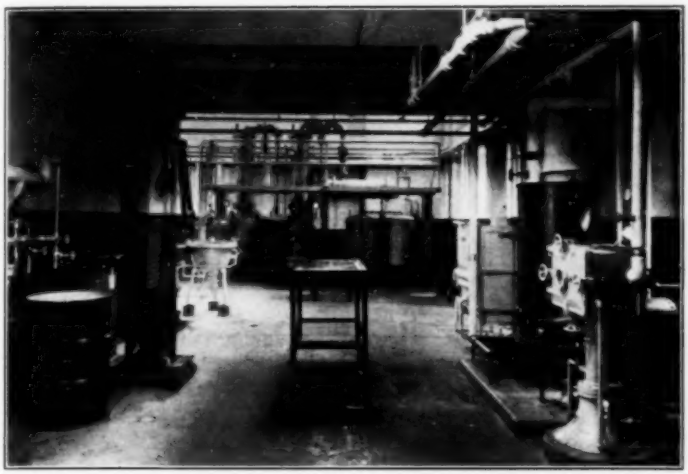
A course in chemical engineering principles, involving the fundamental theory, technique, and equipment of the basic chemical engineering operations and consisting of three hours of lecture and recitation and one six-hour laboratory period is required in the senior year. The treatment is entirely quantitative, and a knowledge of the descriptive details of equipment is obtained largely through reading assignments. Considerable problem work is involved but it is believed not to be desirable to carry out the instruction entirely around problems. A particular effort is made to give the student an understanding of the limitations as well as the utility of the theory in actual practice.

The laboratory instruction is based entirely around the individual unit operations. Semi-commercial equipment representative of the important unit operations is available. In most cases this has been especially designed and constructed for the purpose and permits operation under a wide variety of conditions. This equipment may also be used for research purposes.

The laboratory work is designed primarily to acquaint the student with the influence of operating variables and to illustrate as far as possible the fundamentals underlying each unit operation. Mechanical operation of the equipment is secondary.

Other engineering courses required are engineering drawing, descriptive geometry, mechanics of materials, a laboratory course in engineering materials, and courses in fundamental electrical engineering, engineering thermodynamics, and heat power engineering, the last three in the senior year. At present no course devoted entirely to metallurgy is required for the chemical engineers. A need for this is recognized, and revision of the curriculum so as to include a suitable course in metallurgy is under way. It is also planned to lengthen to two semesters the time devoted to chemical engineering principles.

While the student becomes familiar with tools, machines, and chemical engineering apparatus through the medium of the laboratory accompanying various courses, there are no courses designed primarily for



ANOTHER VIEW OF CHEMICAL ENGINEERING LABORATORY

this purpose, and there is no shopwork, such as forge and foundry. In the summer following the junior year the chemical engineers are required to spend two months in a chemical plant or industrial chemical laboratory approved by the department of chemical engineering, in order that they may acquire the viewpoint of labor in chemical industry and become familiar with chemical plant conditions and chemical engineering in practice.

The preparation of a report on this work is required. There is no special course involving inspection trips but these are made to selected plants at intervals during the junior and senior years in conjunction with the chemical engineering courses. It is felt that the value of extended inspection trips is disputable.

For students proceeding to the fifth year opportunity is provided to complete the technical engineering work omitted from the four-year course by the inclusion of cultural subjects and to do advanced work in chemical engineering and chemistry. There are required two courses in chemical engineering, devoted to an advanced quantitative study of the major unit operations, two elective courses in physical, electro, or colloid chemistry and chemical thermodynamics, two elective courses in advanced organic or inorganic chemistry, and two technical electives. Independent work and the preparation and submission of a thesis on some phase of chemical engineering are also required.

Causes and Cures*

By Charles H. Herty

The war-time president of the American Chemical Society expresses his thoughts on the problems facing the chemical profession.

FOR some five years it was my privilege to talk each month to the chemists of America. I used to enjoy those talks, a group of us sitting around discussing problems of mutual interest, and I regret that I have been away from that kind of contact for a number of years.

Last week when Mr. Breyer sent me a telegram asking me whether I could attend this meeting and speak about something of interest to you, I accepted with much pleasure. I felt one thing very strongly: what a loss it is to the United States that a number of chemists are out of employment!

I remember the days of 1918 and 1919, just after the Armistice. My old office was in the Metropolitan Tower; and every day a string of men came through that office asking me to help them find work or to find food. Those were chemists who had just been demobilized from the United States Army, from the Chemical Warfare Service. Now, as then, it is time for us to look seriously at the situation, and at its difficulties, and to see whether we can do something to better ourselves, to prepare ourselves for the future good times which we all feel are coming back to this country in the next few years.

Chemists ought not sit around and mope. They ought to take courses at Columbia and New York University and City College in those de-

* A speech delivered at the mass meeting of chemists and chemical engineers in the Engineering Societies' Auditorium on March 9th.

partments in which they feel themselves weakest, to improve themselves as much as possible.

BUT to get back to the general situation and its causes. Down South I have been doing research work for a company which has been very successful. They had some temporary difficulties, and the bankers took them over. What was the first thing the bankers did? They discontinued the research work. That was just a month ago.

A little later I had occasion to speak before the Canadian Paper and Pulp Association, and to visit the Forest Products Laboratories in Montreal, where such beautiful work has been going on. That day they had been notified by the directors of the organization that the income for the support of that research work would be summarily cut off.

It is not the real leaders in these industries, however, that are responsible for the laying off of chemical engineers and chemists. It is the bankers and controlling organizations who are doing this. I am going to read you a sentence from an address I gave to the Chemical Salesmen's Association in New York City in November, 1927, just about five years ago: "Are our bankers simply middlemen or brokers, whose only thought is the commission they make; or are they thoughtful leaders, who in their position of great advantage keep constantly in mind the questions of public welfare?"

Not more than three or four weeks ago the president of a great bank at a hearing before a committee of the United States Senate admitted that he was concerned only with the commission he made. That is the answer. The bankers are not interested in the great questions of public welfare, and today these short-sighted financial men are holding industry back.

I want to pay a high tribute to men like Frank Breyer and Doctor Jackson, and others of this committee who have given a lot of their time and their labor toward the betterment of their fellow chemists. There has been a lapse of public education as to the value of chemistry and the services of the chemist. We have got to educate the financiers at the head of the chemical industry. They have not done their full duty.

THE proudest triumph of American industry has been the stock ownership by workmen, a closer and better feeling between employer and employee. We don't hear of riots and bloodshed and sharp, bitter acrimony. It is the most wonderful sight I have ever seen—the way the people of the United States in these terrible times have been helping out their fellow humans. I think our chemical leaders in the

industry, who so generously subscribed a hundred and forty-four thousand dollars, have done a great deal for humanity throughout the country. But we have a still further duty—we come right down to the question of helping ourselves.

GENTLEMEN, the heart of the chemical industry is right here in New York and in New Jersey. We have a real problem on our hands. There is real unemployment. There is real distress. We must all put our shoulders to the wheel. It cannot be left to some men to do all the work; but there must be made up in some way from these nine chemical organizations a strong, militant committee, backed up by men who are willing to work.

I pay tribute to the American Institute of Chemists and the work they have done in the interests of other chemists. They went to the city authorities here, and after a real campaign of education, succeeded in raising the salaries not only of the members of The American Institute of Chemists but of every chemist employed by the City of New York. This was a broadminded act, which drew no distinctions between members and non-members in securing increases in salaries.

I know there are difficulties in the way, but I think it is time for every organization to look into its treasury to see if it has any money that it has put aside for the future. I know of no better investment than to contribute some of that money for the relief of our fellow chemists.

Let us begin to do this thing unitedly. Our nine organizations could afford to be meeting every week on this question. When they call on you to work, go out and work with them in that broad fellowship and spirit of humanity that urges you to do your bit for your fellowmen.

All chemists must get behind this situation and make sure that the chemists in this district do not suffer. Let us see if we can show the country what is being lost by the loss of our services. Let us feel that we are going to formulate a definite plan, with a determination to help improve the whole situation in the United States as well as in the district for which we are responsible.

What the Engineers Have Done*

By John P. H. Perry

The story of the formation of the P.E.C.U., with an account of the work it has done. Unemployment relief as a factor in bringing the engineers together.

THE four founder engineering societies, namely, civil, mechanical, electrical, and mining, organized the Professional Engineers Committee on Unemployment, commonly called the P.E.C.U. This organization was projected about the first of November, and the fundamental reason for its existence was the fact that the officers of the four founder societies realized that the Gibson committee could not do much for engineers, principally because of their specification of what constituted destitution. The definition of destitution was so rigorous that most of the unemployed engineers could not meet it.

Let me tell you of an instance that just came to my mind. A request for relief came to us. A man who was desperate, up against it, with his electricity and gas cut off, was recommended to the P.E.C.U. He wrote in a very sad story, and he said that he knew the definition of destitution was most severe, but he thought he could meet it, as he was a married man with a wife and three children. His rent was months overdue. He applied for a job, at fifteen dollars a week, as he said that in addition to all his other demands he had a lady friend to support, besides his wife!

The problem of the Gibson Committee was fundamentally to raise money, which was then turned over to the great organized charities of the city for administration. These organized societies have professional,

* A speech delivered before the mass meeting of chemists and chemical engineers in the Engineering Societies' Auditorium on March 9th.

experienced social workers. They have the machinery to dispense money with justice and without scandal. P.E.C.U. came into existence without any data upon which to base its work. We had a double load not only of raising money but also to dispose of it when we got it. That is only a part of the difficulties we encountered.

We were perhaps fortunate in that the engineering profession in New York—that is, civil, mechanical, electrical, and mining—is well organized and centers in the four great founder societies. I understand that chemists function chiefly through nine organizations.

AT THE present time beside having the duty of bringing relief to your unemployed fellow members, you have a glorious opportunity to do a great job for your society. I think engineers in general, and I imagine that goes for the chemists and chemical engineers as well as the four founder societies which I have the honor to represent, have been justly criticised for their lack of professional cooperation. Perhaps professional jealousy is too strong; but whatever the reason, they have certainly never been complimented for any solidarity or professional brotherhood.

I think that previously this criticism was certainly just concerning the four founder engineering societies—those who have given the money that we have raised. Now, entirely aside from the relief that they have given, they have operated in a solidarity of professional brotherhood which is going to be of immense value to the society in the years to come.

But just now our question is, what has P.E.C.U. accomplished, and how has it been done? We started, as I say, on November 1st. On the 1st of March we had registered some 2000 unemployed engineers. Bear in mind that I used the word registered. That does not mean that 2000 engineers have applied to us for relief. A lot more than that have applied. As our activities became successful, and as our organization became known in the profession, as well as in industries with which our profession was in contact, a lot of floaters came to us for relief.

When a man applies to us and fills out an application card, the card is then checked up. If he is an engineer, he is registered, otherwise not.

WE HAVE registered, as I say, two thousand men. We have placed nine hundred and sixty men in jobs. The Bliss Committee has asked for four hundred men. How many of those will be taken I cannot say. But I certainly can say that today possibly eleven hundred or twelve hundred unemployed engineers have been placed as a result of

P.E.C.U. activity. That may sound like a big achievement, but there is in addition the bitter, grim fact that there are eight or nine hundred poor devils for whom we have been able to do nothing.

We have raised through the P.E.C.U. something over $90,000, every nickel of it from members of the four founder societies within fifty miles of New York. In other ways we have built up, or rather we have been responsible for putting into the pockets of our registered unemployed engineers, a payroll which today is running close to $100,000 a month.

That payroll is made up as follows: About four-fifths of the wages paid to our men come from the Gibson and Bliss Committees and other relief agencies beside P.E.C.U. The other one-fifth is our own direct payroll, paid out of the $90,000 we have raised.

In addition to creating this fund of $90,000 and putting our registered men into positions as supervisors and keymen with the Gibson, Bliss, and other committees, we have recognized two or three other problems with which we had to deal. One of them was the question of loans; the second was the question of clothing; and the third was the case of the men who were not quite destitute but whose morale was in danger of being broken.

For these latter, we went to Columbia University, who have taken to date one hundred and sixty men whom we have certified to them. Columbia has opened its classrooms so that these men could sit in on post-graduate courses and get their minds ready for new ideas.

Now to come back to the question of loans. We have many cases where men come into our office asking for loans of money. I don't believe that you gentlemen in this audience and those that you represent, until you come face to face with this unemployment problem, have any direct appreciation of this problem of the relief of unemployed men.

We get men who have been receiving salaries of $12,000 and $15,000 a year. They are glad to get $15 or $25 a week jobs. They have got to the point where they have not had a meal in thirty-six hours. These men when identified to our relief people have received loans up to $100, but usually in $25 lots. We have loaned them a total of four thousand dollars. This money is loaned on a simple note, with the hope of getting it back in years to come.

We have also been able through our contacts to persuade the gas company and the Edison Company to withdraw cancellations—that is, the stopping of gas and electric service. We have had eviction notices cancelled. We have helped on legal fees. That, in general, constitutes our accomplishment.

NOW, how has it been done? First, as to the raising of money. We organized a general committee of about forty men who are members of the four founder societies. That general committee functions through an executive committee of six persons. Under that executive committee operate two great committees, one on finance, the raising of funds, and the other on relief.

The finance committee has raised money in general in two ways. We took our membership of some 12,000 local members of the four founder societies and selected a special list of six hundred men who are presumably more affluent than the average run of the mine. Those six hundred names were assigned to the general committee, about fifteen names apiece, and were personally canvassed. We collected about $30,000, averaging a little less than two hundred dollars per contributor. The balance of the money, about $60,000 or $65,000 to date, has been raised wholly by letters of appeal. We have sent out letters of appeal with appropriate literature attached.

Out of twelve thousand members, we have had contributions from about 2500 individuals. We have had letters declining to contribute from about 3500 to 4000 men, so that we are left with about five thousand names from whom we have had no response. We took some nine or ten of the better class of our unemployed destitute, put them on the payroll for relief and sent them out as paid canvassers of the five thousand. We told them to back their men against the wall, and get something from them. That is the way the money has been raised.

Men who come in to apply for relief are classified either A, B, or C in accordance with professional experience and the salary desired. In the A classification are the men who used to get $6000 a year or more. Our nine canvassers at $25 a week were all from that class. They were glad to get $25 jobs; and you have no idea how far that little amount of money goes.

The first ten men went to the Bliss Committee at $15 a week. Within two weeks three of them, through previous contacts, secured themselves permanent positions at $8000, $11,000, and $14,000 a year. That is the type of man who was glad to get $15 a week.

We had to classify men, and I hope chemists are doing the same. Any success the P.E.C.U. has had has been due to the care we exercised in classifying our registrants, so that when we get a call from an organization for a certain type of man we are able to pick out the man suited for that type of job. Thus we have classified the goods we had to sell.

We have classified men in groups A, B, and C again by degrees of

destitution. An A man had to have three dependents. He had to be entirely out of his own funds, and to be with his back to the wall. Right now we have about sixty-five class A destitute men who are desperately up against it. We have some four hundred and fifty-six class B destitutes. And we are facing exactly the same terrible problem that is before the Gibson Committee. Eleven or twelve hundred men are placed in positions, with two hundred that we can carry on our payroll—but only until June.

I AM IN DOUBT as to what is going to take place in the future. I have heard a distinguished economist say that this terrible depression would soon be over, and that none of the previous depressions have lasted for so much longer than this one. But I cannot forget the one that lasted seven hundred years, from the fall of Rome to the beginning of the Renaissance.

We have no means of knowing the end of our problem. Engineers, particularly civil engineers, are being thrown out of work by the hundreds each month. They are being eliminated from municipal and state jobs. Our registrations are increasing weekly. They average about fifty per week. In the last three weeks of February they averaged a hundred and fifty a week. We are going on the assumption that we shall have before us a bigger job next winter than we have had this winter.

The Unemployment Committee*

By D. D. Jackson

The head of the chemical engineering department of Columbia tells about the preliminary stages of the workers' volunteer committee.

THE Committee on Relief and Unemployment for Chemists and Chemical Engineers, which operates among the nine chemical organizations in the metropolitan area, has been functioning for the last ten weeks.

The first operation was to take as complete a registration as possible of those out of employment. Then we arranged them in classes, A, B, and C, rather differently from the engineers in that our class A represents those who required immediate need—who were in very dire straits. Class B were a little better off, and therefore waited while we tried to place the class A men; but in the course of events many of the class B men had to be transferred to class A.

We have attempted to find employment for these men, particularly the needy cases, and we have also tried to assist them as regards advice about employment. In some cases we have helped with money and with occasional meal tickets.

I don't think many of us realize how many of our profession are in dire necessity at the present time. Something like twenty per cent of the chemists in this metropolitan district are out of employment; and most of them have not very much laid aside. I particularly wanted to present tonight the statistics we have gathered in our work.

The number of chemists and technical men normally employed in the

* A speech delivered at the mass meeting of chemists and chemical engineers in the Engineering Societies' Auditorium on March 9th.

metropolitan area—that is, within a radius of fifty miles from City Hall—is about ten thousand. The number at present unemployed is estimated as from fifteen thousand to twenty-five hundred. I think two thousand is a fair figure on that—though it seems that chemists are susceptible, sensitive people, so that it is difficult to get them to register. In one case, where a concern laid off twelve men, we could get the registration of only two of these twelve.

BY THE first of March we had registered 415 men. In the employment bureau of The Chemists' Club they have some 750 other men, also registered, making a total of eleven or twelve hundred men that we can account for. Of the 415, we have placed in the short time that we have been working 26 men. We have sent to the Emergency Work Bureau 125. Some of those will be taken care of, but not all of them.

Of these unemployed about 22% belong to the American Chemical Society. I should like to emphasize that a bit—22% belong to the American Chemical Society. The members of other societies were 15½%. Those in dire need were 85—that is, about 20% of our registration.

Of those registered 80 per cent were graduates. Those who wanted from $5000 or more were twelve per cent; $3600 to $5000, thirty-five per cent; from $2400 to $3600, twenty per cent. The number out of work for six months was 33%, and the number out of work for more than a year was 14%.

We have tried to get positions for these people, and are still trying. We are doing what we can with the facilities we have. There is no question at all that no two of these nine organizations have any use for each other. Apparently there is no organization. The engineers have gotten together, as they always have, so that their societies are well organized. They started working long before we did, and I assure you they have accomplished something. We have accomplished what we could in the short time that we have been working; but what we hope to do is to get a greater cooperation between these various organizations.

Annual Meeting

THE Annual Meeting of The American Institute of Chemists will be held at The Chemists' Club, 52 East 41st Street, New York, N. Y., on Saturday, May 7, 1932.

The program is as follows:

12:00 M. Luncheon of the National Council.

1:00 P. M. Business meeting of the National Council.

3:00 P. M. Annual meeting of the Institute for the consideration of and action upon submitted amendments to the Constitution, and for the consideration of such other business as may be properly presented. The results of the annual election will be announced at this time.

7:00 P. M. Annual dinner.

8:00 P. M. Presentation of the medal of The American Institute of Chemists to Dr. Charles H. Herty.

SPEAKERS

John H. Finley, associate editor, *The New York Times*.
Henry W. Jessup.
Marston T. Bogert, professor, Columbia University.
Joseph E. Ransdell, formerly Senator from Louisiana.

All classes of members are privileged to attend the Annual Meeting, as well as the dinner and medal award.

Notice of the proposed revisions of the Constitution has already been mailed to the membership. If any member has failed to receive such notice, he can obtain a copy of the suggested changes by writing to the office of the Secretary.

Chemistry Takes the Guesswork out of Petroleum Refining

By J. B. Rather

The history of the development of the petroleum industry, showing the various steps as it evolved into an exact science.

THE American petroleum industry is of comparatively recent origin, though the earliest authentic use of petroleum in America was by the Indians, who skimmed crude oil from oil springs and used it as a remedy for many ailments.

In 1833 "Seneca Oil," obtained from a spring near Lake Seneca, New York, was sold as a medicine; and as late as 1855, crude oil was marketed at a dollar a pint by Samuel Kerr, a druggist of Pittsburgh. Kerr found that the production far exceeded the sale and developed the fact that by a simple distillation he could obtain an oil useful for illuminating purposes.

In 1855 a sample of "rock oil or petroleum" was sent to Benjamin Silliman, Jr., of Yale University, who made a study of the product for the Pennsylvania Rock Oil Company. He fractionally distilled the oil and studied the behavior of various reagents on the fractions. His report as finally submitted was the first systematic investigation of petroleum and gave important information on its chemistry and utilization.

The first oil well in America was drilled by Col. E. L. Drake at Titusville, Pa., in August, 1859. Prior to this time, the production of crude oil had been negligible but a year after the completion of the Drake well thousands of barrels of petroleum were being produced in the Pennsylvania fields. The question naturally arises as to how this vast increase in petroleum was absorbed.

The answer to this question lies in the fact that in 1860 there were fifty-three coal oil companies in the United States manufacturing illuminating oil from coal and operating under licenses from the Young Company of Scotland, where the coal oil industry had reached a high state of development. The methods and facilities for refining and marketing coal oil were adapted to petroleum; and the early sixties found a well-developed petroleum industry in the United States. One of these coal oil companies, the North American Kerosene Gaslight Company, was located at Newtown Creek, Long Island, on the approximate site of the present general laboratories of the Standard Oil Company of New York.

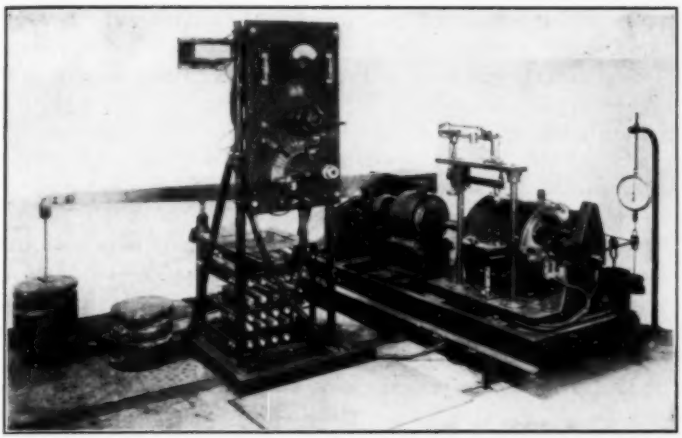
It is interesting to note that even in those days the oil industry suffered from overproduction. In 1860, Pennsylvania Crude Oil commanded a price as high as twenty dollars a barrel and the following year dropped to ten cents a barrel.

The earliest refining methods and equipment were exceedingly crude. The stills used were little more than pots equipped with condensers. Only two main products were manufactured, kerosene and lubricating oil. Thousands of barrels of gasoline were burned or dumped into streams because there was no market for the product. Chemical treatment was limited to the use of sulphuric acid on kerosene; the lubricating oil was sometimes filtered through fuller's earth but more often was not treated at all.

Compare this picture with the situation today, in which we have single-pipe still distillation units equipped with bubble towers which are capable of handling 20,000 barrels per day of crude oil, taking off several streams of distillate simultaneously. Instead of manufacturing only two products from crude oil, today hundreds are made, and every portion of the oil is utilized.

The Desulphurization Problem

One of the early problems encountered in the oil industry arose through the production of sour crudes, containing high percentages of sulphur. These crudes did not respond readily to the conventional methods of treating with sulphuric acid, sodium plumbite, and other agents; and consequently large quantities of crude oil from Ohio and Indiana were practically unusable until 1921 when Herman Frasch, a chemist, found that by distillation of these crudes over copper oxide, sweet products of low sulphur content could be obtained. The Frasch process has long since passed into discard, largely because the supply of these refractory crudes has been depleted. The present-day crudes



EVALUATING LOAD CARRYING CHARACTERISTICS OF LUBRICANTS

respond more satisfactorily to treatment with sulphuric acid, liquid sulphur dioxide, hypochlorite, and sodium plumbite.

Drastic treatment of cracked gasoline with sulfuric acid for purposes of desulphurization, if carried out at atmospheric temperature, results in a polymerization of valuable unsaturated hydrocarbons which impart anti-knock characteristics to the gasoline. It was found, however, that such treatment, if performed at a temperature of 5° F., resulted in a 30 to 70% reduction in treating losses and a 40% saving in acid.

The discovery of the cracking process in 1861 is said to have been purely accidental and was due to the failure of a stillman in Newark, N. J., to return to his still for a period of four hours, when he should have returned in one. When he did return, he found that the heavy residue which the still contained was producing a light distillate.

For many years little or no practical use was made of this discovery, because there was little demand for gasoline. With the development of the automobile, however, the demand for gasoline exceeded the production. In 1912, Dr. W. M. Burton, a chemist, developed the first practical cracking process. Since that time great strides have been made in cracking processes. Today we have units operating at 1000° F. and several hundred pounds pressure, converting thousands of barrels of heavy fuel oil into gasoline.

The introduction of cracking brought many new problems to the industry. Special steels had to be developed to withstand the high

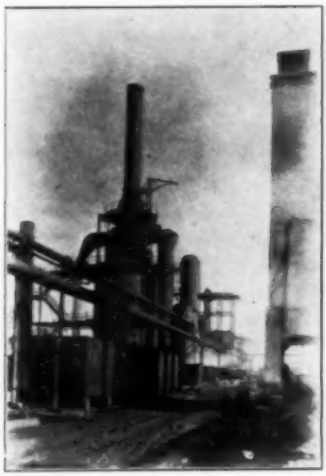
pressures and temperatures. New treating methods had to be developed to refine cracked gasoline suitably without sustaining large polymerization losses; and the gas, coke, and residua from cracking operations had to be economically utilized.

By the absorption in sulphuric acid of the unsaturated hydrocarbons from pressure still gases, followed by hydrolysis of the sulphuric acid esters formed, alcohols are produced; and a large business in solvents of this character has been developed.

Chemists and chemical engineers have assisted materially in all these developments.

Anti-knock Gasolines

The use of high compression ratios in internal combustion engines gives improved performance and fuel economy, but for many years a definite limit was set to the improvement which could be effected in this direction by detonation (due to too rapid combustion) of the fuel when the compression pressure exceeded certain limits. This detonation resulted in a loss of power and uncertain engine performance. It was early demonstrated that the phenomenon of detonation was associated with the chemical composition of the fuel. Paraffins, olefins, naphthenes, and aromatics showed decreasing tendency to detonate in the order mentioned. Aniline was also found to be effective, when added to a detonating fuel, in decreasing the tendency to knock.

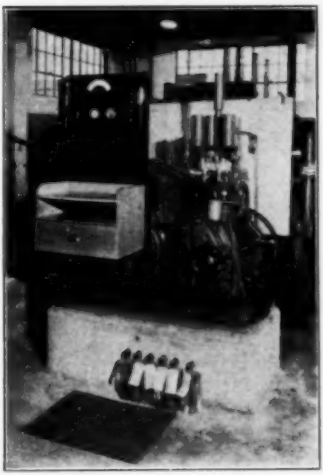


CRACKING UNIT

So important was this problem of detonation that the General Motors Corporation made an exhaustive study of the phenomenon. Accurate methods of quantitatively measuring knock were developed. Photographic studies of flame propagation were made and the knock inhibiting effect of thousands of compounds was determined. As a result of this work, carried out under the direction of Kettering, Boyd, and Midgley, lead tetraethyl was discovered to be a most effective knock inhibitor;

and this material today is the active constituent in ethyl gasoline.

Petroleum refiners, on the other hand, directed their attention to converting the hydrocarbons in gasoline into those types which showed a decreased tendency to detonate. New vapor phase cracking processes, operating at temperatures in excess of 1000° F. were developed, and such processes are used today in producing gasolines high in aromatics and of high anti-knock value.



APPARATUS FOR DETERMINING DETONATION CHARACTERISTICS

Oxidation

Petroleum products in storage and use undergo oxidation, which results in a depreciation of their quality and in some instances renders them unsuitable for the purposes for which they are intended. Gasoline develops gum, which causes sticking of valve stems, clogging of carburetor jets and fuel line; kerosene discolors; lubricating oil develops sludge and acidity; paraffin wax becomes odorous and discolored; transformer oils develop sludge and acidity.

Considerable progress has been made in the development of suitable negative oxidation catalysts for preventing the deterioration of gasoline, kerosene, and transformer oil. These agents are effective in concentrations as low as one-thousandth of one per cent.

Negative oxidation catalysts are of particular value in preventing the formation of gum in gasoline; and they enable the distribution of a stable product which need not be refined by excessive and expensive acid treatment, which treatment also results in a loss in anti-knock quality of cracked gasoline due to polymerization.

Development of Low Pour Test Lubricating Oils

One of the necessary requirements for a lubricant for use at low temperatures is that it shall flow readily to the parts to be lubricated. All oils from paraffin and mixed base crudes contain paraffin wax or petrolatum which have to be removed in order for the oil to flow readily at low

temperatures. In the case of the lighter distillate stocks this is accomplished by chilling and removing the wax with a filter press.

Many improvements have been made in the methods of doing this, such as the use of diluents in which the wax is substantially insoluble and by the use of filter aids. The heavier residual oils were formerly diluted with naphtha and stored in settling tanks during cold weather to allow the petrolatum to settle out. This method made the refiner the victim of the weather, and a single warm day could spoil the production of a whole year's cylinder stock. With the introduction of refrigeration and continuous centrifuges, an improved product of uniform quality was produced.

Flow Point Lowered by Chlorination

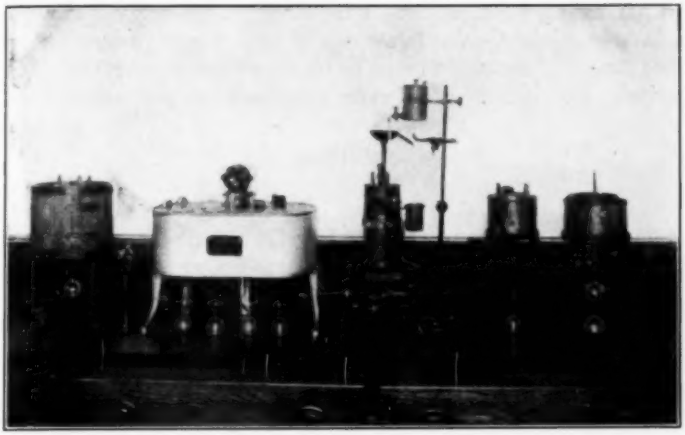
Recently a material has been discovered which, added to an oil in a concentration as low as one per cent, will depress the pour point 40° F. This material is a hydrocarbon prepared by chlorinating paraffin wax, and then condensing this chlorinated wax with naphthalene by the Friedel and Craft reaction. This condensation product, which in its physical characteristics resembles cylinder stock, is "Paraflow."

By the use of this material low pour test oils are obtained without complete dewaxing. It is obvious, of course, that an enormous saving in processing equipment costs is thereby effected.

Some years ago it was found that certain Rumanian crudes, because of their high content of aromatic hydrocarbons, gave kerosene oil which smoked badly in a lamp and had a low photometric value. The problem of successfully handling these crudes was solved by Edeleanu, a Rumanian chemist. He found that liquid sulphur dioxide, at low temperatures, exerted a selective solubility on aromatic hydrocarbons; and he developed a commercial process for the continuous extraction of kerosene with liquid sulphur dioxide. One of the advantages of this process is that the extracted aromatic material as well as the liquid sulphur dioxide can be readily recovered in a usable form without loss. Millions of gallons of kerosene are yearly being treated by this process. It is also being successfully applied to lubricating oils, the production of anti-knock fuels, and high solvent power naphthas.

Asphalt

Asphalt has been known and used since the year 3000 B.C. A marble statue of one of the early Sumerian rulers, unearthed in Syria between the Tigris and Euphrates rivers, was found to have hollow eye sockets which still showed the presence of the asphalt used to hold in place eyes which



VISCOSIMETERS USED IN VARIOUS COUNTRIES

were probably of some semi-precious material. The word asphalt itself is of Babylonian origin.

Asphalt, prior to the discovery of petroleum, was obtained from natural pools and lakes, perhaps the most famous of which is on the Island of Trinidad. This asphalt lake, 2000 feet across and 135 feet deep, is estimated to contain 9 million tons.

After the discovery of petroleum it was soon found that an asphalt superior to the natural product could be produced from the residua obtained by the distillation of asphaltic base crude oils. It was also discovered that by blowing such residua with air at elevated temperatures hard asphalts of high melting point, suitable for roofing, paints, and impregnating purposes could be produced.

Asphalts are also being produced from pressure still tar, which is a highly polymerized material resulting from the pyrolysis of gas or fuel oils and is a by-product of cracking operations.

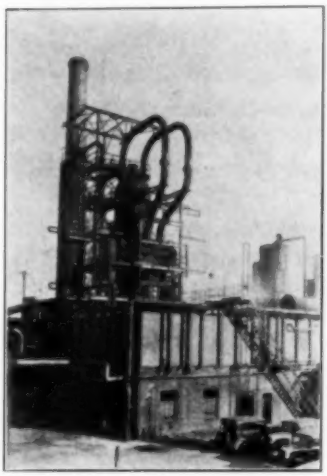
With the advance in motor car design, hypoid and worm gears have been developed in which tooth pressures as high as 150,000 pounds per square inch obtain. Under these extreme pressures it is impossible to maintain a lubricating oil film. To lubricate such equipment special lubricants containing lead soaps, sulphur, or chlorine compounds have been developed.

At the temperatures obtaining at these high pressures, these materials break down and liberate metallic lead, hydrogen sulphide, or hydrochloric

acid. These agents either attack the steel of the bearings, forming iron sulphide or chloride, or, as in the case of lead, simply plate the bearing. These films prevent steel to steel contact and eliminate seizure, thereby affording efficient lubrication under these extreme conditions.

Testing

In the early days of the petroleum industry there was little uniformity of products. Quality was controlled by general appearance, touch, and odor. The hardness of asphalt, for example, was controlled by the stillman chewing a piece of it and the consistency of grease by the grease-maker sticking his finger in it. None of the methods were standardized, one oil company using one method and another company a different one.



MODERN CONTINUOUS STILL. THIS STILL DOES THE WORK OF TEN BATCH STILLS

The Standard Oil Company, which up until the time of its dissolution, was the largest single unit in the industry had its own methods of test fairly well standardized. The Standard Oil inspection division under the supervision of George M. Saybolt developed numerous new test instruments and methods of test, many of which are still used today. The instruments were manufactured practically exclusively by the Tagliabue Company of Brooklyn.

In 1904, a committee of the American Society of Testing Materials was organized to standardize and develop suitable methods for testing petroleum products. At present, this committee, now designated as Committee D-2, has a membership of 81 and has developed 49 standard and tentative methods of test. In addition, this committee also assists in the formulation of specifications for various government departments, states, and municipalities.

The foregoing, we believe, indicates how intimately chemists and chemical engineers have been associated with the petroleum industry and how through their efforts this industry which was non-existent in 1855, has risen to first rank today.

Chemistry and Currency

By L. V. Redman

The president of the American Chemical Society discusses some economic implications of chemistry. Abstract of a speech before the Washington Chapter of the A.I.C.

WE CHEMISTS take too little interest in problems connected with the distribution and utilization of the wealth that our science creates. The difficulty seems to be that public interest centers in money, which at present only imperfectly represents wealth. The wealth that science creates is better measured by production per man per hour; and the character of the service may be measured by the thing produced.

We all tend to think of gold as wealth; but as the basis of currency, its increased or diminished production has only indirectly to do with wealth. Fluctuation in the world's supply of gold greatly influences prices, which in turn, have much to do with prosperity; but this is another matter. If this basis of our monetary system were discovered in such amount as to double the world's supply, prices of labor and commodities would tend to rise until they also were double. This would stimulate manufacture and commerce, since the manufacturer and the merchant could expect an added profit because of a rising market; and wealth would increase, because nearly everybody would be at work. But when conditions reach adjustment, whichever way prices may tend, a man will receive no more or no less in goods for his day's work than if prices had remained where they were.

Gold, therefore, as the basis of currency, affects the production of wealth only as by fluctuation it tends either to provide or to take away opportunity for productive work. It is with making work more produc-

tive and with making the things produced more desirable, that our science is concerned.

We as chemists may not know much about commerce and finance; but those who claim to know are plainly unable to say how business and money may be stabilized and creative industry be permitted to produce wealth uninterruptedly. We do know something about the conditions under which scientific research may be depended on to continue to create wealth, if only those in control of finance have the vision to support it. It is the management of research, its hazards, and its conditions for success, that I wish to speak.

FIRST, let us consider the hazards of investment in research as compared with other investment.

A good bond or other safe investment brings relatively small returns, say five per cent. This is because the risk is small.

Return from investment in a more or less standardized industry or business is greater; let us say twelve and a half per cent. The risk is also somewhat greater.

Investment in research and its industrial application called development is still more hazardous and must, if successful, bring returns commensurate with the increased hazard and the greater length of time that the invested capital is nonproductive. Experience shows that on the average it will be seven or eight years before the investor may hope to get his money back. Then he should expect to get thirty per cent or more in his investment. Otherwise, he would be unwilling to risk his capital.

Research proper, the preliminary, small-scale work, is less of a hazard than is development. In fact, research well conducted tends to pay its own way. If it leads to nothing new in process or product, at least it will have cost little and may give knowledge of great future value.

It is when research points the way to new processes or new products that large hazards enter. To proceed with development means largely increased expenditure, with the chance that the whole investment may be lost. To fail to proceed, on the other hand, may mean lagging behind in the race for industrial supremacy, while others who are willing to take the risk reap the rewards of leadership.

A TYPICAL case is one in which research conducted for a period of perhaps two years leads to development costing ten times as much and proceeding for the next two or three years without return. Then sales may be made, bringing in increasing return as the product is

adjusted to meet the demands of the market. After seven or eight years, if all goes well, one may reasonably expect to have the whole investment in hand and be on the way to a profit that will compensate for the hazards, to say nothing of the time and trouble, incident to such a venture.

Every individual development project represents a real hazard, one that the small investor may do well to hesitate to take. Still, when development is well chosen from among a considerable number of research problems, the hazard is less. When the program is broad enough to include a number of well chosen development projects, the hazard is plainly further reduced. Returns on those projects that are successful should offset the failures and leave a handsome margin for the investor.

Such a venture into development calls for adequate available capital and it calls for courage. One must be willing to see one's investment rapidly disappear from view and be willing to wait years for its return, with the chance that it may not return at all. But if there is hazard in seeing the project through, there is certain failure in abandoning it at the period of greatest depression. Better make no start than fail in capital and courage. The time of greatest discouragement may be just before the project is recognized as a success. After this it becomes a going thing, a good risk for any man's money.

The creative value of a broad program of research, however, has been shown to be certain and large. The results must justify not only the patient labor and risk involved; they must, in the long run and the world over, pay for the products and equipment that are thereby rendered obsolete. That such have been the results of research and its application is attested by the increase of wealth that has come to the world since creative science began its work.

Chemistry and Military Explosives[1]

By C. G. Storm

The chief of the Explosives Section, office of the Chief of Ordnance, traces the development of high explosives and discusses some of the present chemical problems.

THE development, during the World War, of the methods of warfare termed "chemical warfare" (which are said to have originated with the use of poisonous or suffocating gases by the Spartans in their wars with the Athenians in the 5th century B.C.) brought the chemist into the spotlight and created unlimited opportunities for the exercise of his talents in producing toxic and lachrymatory gases, smokes of various types, and reliable means of protection against such materials.

Since the fourteenth century, however, all warfare between civilized nations has been essentially "chemical warfare." The utilization of black powder for propelling missiles from cannon made the chemical industry a vital factor, and the later development of smokeless powders and of high explosives suitable for use as bursting charges still further emphasized the importance of the chemist as a military asset.

From the first use of black powder in warfare up to some years after the Civil War, progress in the development of military explosives was very slow. Beginning with about the middle of the nineteenth century, however, the application of chemistry to the subject of explosives became active. There followed in rapid succession the discovery of guncotton by Schönbein in 1845, of nitroglycerin by Sobero in 1846, of various ammonium nitrate explosives by Ohlsson and Norbinn in 1867, of the various so-called Sprengel explosives in 1871.

The fact that picric acid could be detonated was also discovered by

[1] Published by permission of the Chief of Ordnance.

Sprengel, but no practical use was made of it as an explosive until 1886, when Turpin proposed it as a filler for high explosive shells. The development of smokeless powder began with Schultze's powder in 1865, which was improved upon by Volkmann in 1871 and by Reid and Johnson in 1882. These powders were used chiefly in shot guns and were unsuitable for use in rifled guns because of their rapid rate of burning. Vieille in 1886 produced the first successful smokeless powder from colloided nitrocellulose (poudre B), and Nobel in 1888 introduced his colloid of nitrocellulose and nitroglycerin known as ballistite.

Once Begun, Development Becomes Rapid

Rapid strides now took place in the improvement of both small arms and cannon, and in ammunition for them, the way for this being paved by the development of smokeless powders of high energy content, whose rate of evolution of energy could be controlled by colloiding the nitrocellulose and forming this colloid into dense grains of size and burning surface especially adapted to each type of weapon.

As cannon improved, greater demands were made on the explosives chemist. Smokeless powders must meet requirements for increased range and greater accuracy of fire, and at the same time must not cause excessive erosion of the rifling. The high explosives used as bursting charges in the projectiles must be sufficiently powerful to produce the desired effect when the shell has reached its target, but must be insensitive enough to withstand the terrific force of set-back resulting on firing of the gun, so as to avoid the possibility of premature explosion in the bore.

The Ordnance Department of the United States Army is responsible not only for the supply of arms and ammunition to the Army, but for all research and development work connected with such materials. The Picatinny Arsenal, located near Dover, New Jersey, includes among its facilities a factory for the manufacture of smokeless powder, semi-scale plants for the experimental production of smokeless powder and high explosives, and research laboratories. This arsenal conducts the research work of the Ordnance Department related to the subject of military high explosives and propellants, under the general direction of the office of the Chief of Ordnance. Some idea of the chemical problems involved in the development and production of military explosives may be obtained from a discussion of a few examples.

From the time of the adoption in about 1899, by both the Army and Navy of the United States, of the type of nitrocellulose smokeless powder known as "pyro" powder, (an ether-alcohol colloid of nitrocellulose, of

about 12.60% nitrogen) until after the termination of the World War, practically no change was made in this type of powder. Experience gained in the manufacture and use of large quantities of this powder during the War, indicated, however, the desirability of developing a powder which would be flashless as well as smokeless, and which would be less hygroscopic than pyro powder.

A systematic study was undertaken to determine the effect of the incorporation in the nitrocellulose colloid of a large variety of substances proposed as flash-reducing agents, non-volatile solvents or plasticizers, non-hygroscopic agents, etc. This work involved the manufacture of a great many experimental powder samples, their ballistic testing by actual firing in guns, and study of their chemical and physical properties, and was undertaken with the cooperation of the commercial manufacturers of smokeless powder.

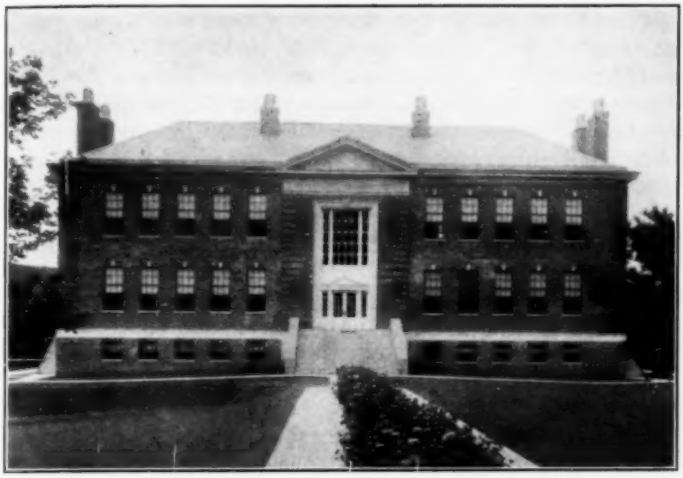
As a result of this cooperative work, the Ordnance Department has adopted an improved type of smokeless powder as standard for a considerable number of both small and large types of artillery ranging from the 37-mm. gun to the 12-inch gun. This powder produces no muzzle flash in some of the smaller weapons, such as the 75-mm. field gun and the 105-mm. howitzer. It has not yet been found possible to eliminate the flash of the larger weapons without modifications in the composition which likewise result in the production of very objectionable quantities of smoke.

Although not entirely non-hygroscopic, the new powder absorbs under given atmospheric conditions less than one-half as much moisture as the old type of pyro powder. Since moisture increases the tendency of nitrocellulose powders to undergo decomposition, and since changes in the moisture content of the powder produce variations in ballistic effect, it is apparent that the new powder should be superior to the old, as regards both chemical and ballistic stability. This has been confirmed by tests covering a period of more than seven years.

Still Problems to Solve

In spite of the marked progress that has been made, the problem of developing improved smokeless powders is by no means regarded as completely solved. Experimentation is being continued with the hope of finally eliminating the muzzle flash of even the major caliber guns, of effecting further reduction in the amount of smoke produced, and of further improvement in the uniformity of ballistic results.

An important factor in the last mentioned item is no doubt the uniformity of the colloid of which the powder grains are composed. A



MAIN BUILDING, PICATINNY ARSENAL CHEMICAL LABORATORIES

study has therefore been undertaken of the microscopic structure of smokeless powder colloids, and the effects produced therein by the incorporation of various flash-reducing agents, plasticizers, etc. This work has led to information of much importance in connection with the processes of manufacture, and has greatly increased our knowledge of nitrocellulose colloids.

It has long been known that nitrocellulose smokeless powders have a tendency to undergo hydrolytic decomposition on long storage, particularly in warm climates. Large quantities of the smokeless powder left on hand at the close of the World War have been disposed of by salvage because of deterioration of this nature. That this decomposition is not the result of any inherent instability of the nitrocellulose molecule itself, is apparent from the fact that some lots of powder become unstable much more rapidly than others. Some lots are still in excellent condition after a life of twenty-five years. It is also significant that certain grains in a lot of powder become badly deteriorated while the balance of the lot is still in excellent condition.

These facts may be explained by the presence of traces of acidity left in or adsorbed by the nitrocellulose fibers in spite of the pulping and the many boiling and washing treatments of the purification process. Experimental studies of the purification of nitrocellulose have shown that it is possible to prepare a product that is entirely free from acidity.

It was found that the electrometric method permitted accurate determination of traces of acidity, whereas the titration method gave consistently high results because of adsorption of alkali by the nitrocellulose. This work is being continued in the hope that it will lead to the development of plant processes of purification which will greatly increase the stability life of smokeless powder.

Raw Material Problems

Purified cotton linters is the raw material generally used for the manufacture of nitrocellulose for use in smokeless powder, largely because of its availability and low cost. It must be properly bleached and purified in order to comply with War Department specifications for cellulose. Another excellent source of cellulose is purified wood pulp, from which practically all of Germany's war powder was produced. The pulp is usually made into paper (preferably crêped), which is then shredded or cut into small pieces to facilitate handling in the nitrating and purifying operations.

The Ordnance Department is conducting studies of the various commercial pulps available in this country, to determine their relative suitability for nitrating purposes. Because of purification losses and the cost of converting the pulp into paper, there is no apparent economic advantage in the substitution of wood pulp for linters. The chief consideration is the possibility of a shortage of linters in time of war. Such a shortage was threatened during the World War. Very encouraging results have also been obtained by nitrating wood fiber specially prepared in "tufted" form, similar in appearance to short-fibered cotton, although the present cost of such material is considerably higher than that of purified linters.

Black Powder Still Used

Although black powder has not been used for many years as a military propellant, it still has certain military uses for which no better material has been developed. It is employed as the bursting charge in shrapnel, as an igniter for smokeless powder charges, and as delay powder in time fuses for anti-aircraft ammunition. Much effort has been concentrated on the problem of developing slow-burning black powder compositions which will, when highly compressed in the time rings of such fuses, burn with the desired uniformity of rate so that the shell will explode at the proper time. This problem is complicated by the fact that the rate of burning of such explosives varies with changes in at-

mospheric pressure, and that the latter varies with the height of the trajectory of the projectile.

There are also many chemical problems in connection with military high explosives used as bursting charges in shell, bombs, and grenades. Satisfactory military explosives must comply with the following conditions:

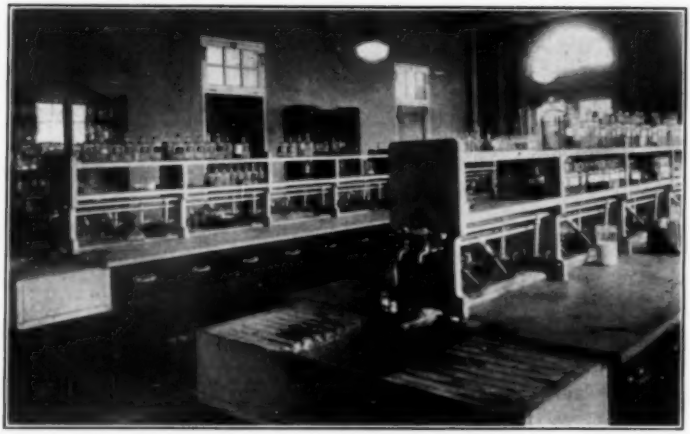
1. They must utilize raw materials which can be readily procured in sufficient quantity to meet the demands of war-time requirements.
2. They must be capable of being manufactured in a practicable manner on a large scale, without undue hazard and at reasonable cost.
3. They must function with certainty in the ammunition in which they are to be used.
4. They must retain this ability to function after prolonged storage either in bulk or when loaded into ammunition.

Deterioration Problems

In peace-time development all of these factors can be given due consideration, while in time of war, unexpected shortages of raw materials may force the adoption of less satisfactory substitute explosives. Thus, during the World War certain standards of quality were lowered in order to facilitate production. As a result, various types of deterioration have been encountered in the continued storage of the large stocks of ammunition left on hand at the close of the war. Investigations of the nature and causes of such deterioration have given much valuable information as to the effect of various impurities on the keeping qualities and functioning of explosives, the efficiency of various means employed to prevent action of the various explosives on the metals with which they come in contact when loaded, etc.

An illustration of deterioration of this nature is the exudation of TNT charges in shell and bombs. Although crystalline TNT stored in bulk undergoes no change whatever during long periods of storage, even in warm climates, it was found, a few years after the World War, that many of the cast TNT charges of shell and bombs (especially those stored in the southern parts of the United States) were leaking a dark, viscous, oily liquid, this exudation being sometimes accompanied by the evolution of gas pressure.

A study of this exudate revealed two major causes: (1) the formation of low-melting eutectic mixtures by TNT and its residual impurities, such as dinitrotoluene and the isomeric trinitrotoluenes; (2) the action of alcohol on TNT to form products soluble in these eutectic liquids.



ANALYTICAL LABORATORY, PICATINNY ARSENAL

The gas evolved was found to be ethyl nitrite. Traces of alcohol in the charge may be due to alcohol used for recrystallizing the TNT in the process of manufacture, or to shellac used for coating the interior of shell and booster cavities. The obvious remedies for the trouble are therefore the elimination of the use of alcohol in the purification of TNT and in the shell coating, and the requiring of a higher solidification point for the TNT, which will necessitate more complete removal of impurities produced in the process of nitration.

Must Keep in Mind Practicability

In formulating specifications for military explosives and for the raw materials entering into their composition, the chemist must not fail to give due consideration to the practicability of his requirements. Unduly severe specifications may greatly hamper or entirely prevent production in time of emergency. Full cooperation with industry is therefore essential in the preparation and revision of specifications.

While the highest possible degree of purity in an explosive is usually the best assurance of its stability and proper functioning, it is sometimes necessary to choose between a deficit in the supply of the explosive and a modification of the specifications so as to facilitate production. It must, therefore, be the business of the chemist to know the extent to which any appreciable change in the requirements of the specifications

will affect the quality of the product. Extended research and practical tests are necessary to obtain this knowledge.

The war-time supply of explosives may also be seriously affected by shortages in the supply of essential raw materials. Substitutes for the explosives approved as standard for various purposes must therefore be made available. This search for suitable substitutes has involved the preparation and study of the explosive characteristics and chemical properties of many compounds, some of which were well known, and some of which had probably not previously been investigated in this country.

Substitutes Developed for Emergency Use

In this manner, the value of a considerable number of explosives for specific military purposes has been definitely determined. It is known, for example, that certain explosive mixtures which have the essential properties of shell and bomb explosives, and which do not require the use of toluene as a raw material, can be made available in large amounts in the event of a possible shortage of this essential raw material for the manufacture of TNT. Similarly, there have been found possible substitutes for all of the standard explosives. New explosives announced from time to time in the literature are constantly being investigated in the hope of developing improved types which will be superior to the present standards.

The importance of the work briefly discussed above as an item in the military preparedness of the country is obvious. Such development and research work must be carried out in government laboratories and plants in time of peace. At such times the industries give little thought to ammunition problems, but in time of war they look to the government for detailed information as to the materials required and the methods by which they may be produced.

The Outstanding Oilman

By Carleton Ellis

The story of Walter C. Teagle, president of the Standard Oil Company (New Jersey). A chemical executive who met the crises arising from war conditions.

MY GUIDE was waiting at the station in Longview, Texas, when I arrived for a visit to the East Texas oil field. He was a good scout—that guide—and a big fellow, too. Physical bigness seems to be no mean asset in the oil industry. Witness, for example, Walter C. Teagle, who has so increasingly urged his huge frame along the Lincoln Highway of petroleum to a place destined for him at the top.

For a moment, however, let us return to the East Texas oil field, a tract stretching through four counties over a length of nearly forty miles. We set forth in a light auto. The guide, a college-trained engineer, by the way, soon needed all his attention and his entire strength to manipulate gear shift and steering wheel of the car as we hopped and skidded amidst the mud of the road.

When one bowls along well-paved roadways, it is difficult to realize the discomfort of riding (to say nothing of driving) a light car through the bogs of an improvised road. Some measure of that realization reached me, however, on that oil-field inspection trip.

A moment of suspense as the cars mired to the hubs then climbed a seemingly impossible ledge to bump happily along a stretch of boulevard made by laying poles crosswise of the way.

"Corduroy road," I remarked.

"We call it Arkansas pavement," he said.

We passed a low farmhouse with oil derricks in the background. It

was the home of Pa S who had leased the mineral rights of the farm to an oil company.

Pa was sitting on the stoop, so we stopped for a chat. I found that the eighth interest he received for the lease of his mineral rights was bringing him about $2800 per month.

"What are you going to do with all your money, going to travel?" I asked.

"No," he replied, "Ma and me don't care to travel."

"Well," said the guide, "Pa will drive about soon in a new car, I expect."

"No," said Pa emphatically, "the old car is good enough for Ma and me."

"How do you like raising a crop of oil?" I asked.

"Don't like it," was his comeback, "they are digging up the ground so I don't know if I can ever get it back in shape for farming."

As we parted, I made a final suggestion. "I know you would enjoy a trip to Europe."

"Can't be done," he said rather irritatedly, "Ma's going to take some boarders." Not everyone is spoiled by an overdose of prosperity.

We passed a derrick where drilling was in progress.

"My first job was on a drilling rig," said my guide.

"How did you like it?" I asked.

"It's all right if you can overlook the ragging. Some college men come here and quickly find they cannot stand the life. I was requested, on the first forenoon of my employment, to go over to the crew on the next well and borrow a *left-handed* monkey wrench. I was unable to locate one. Then in the afternoon, during a moment's lull, I was asked to go to the shop and get a *pipe-stretcher*. Later I was delegated to get some *sky-hooks*."

"Well finally," I interrupted, "what was the outcome in your case?"

"Why, this way," said he. "By the end of the second day I found that a new man on the rig was called a 'boll weevil' and had to be broken in by devious ways. A college man particularly was likely to get it in the neck. So I resolved the third day not to be made the goat. Soon I was asked to go to a certain location and bring over some 'doll heads.' I thought the time had come to take a stand so I laughed off the request as just another practical joke, and an older man was sent in my stead. He returned with grooved wooden blocks used as supports for rod lines. These, I found, were actually termed 'doll heads.' I soon learned, too, that an order to put four foot of gas in the boiler meant feeding in a few four-foot lengths of cordwood; and so on and on. I tried to keep good-

natured with the gang and found after a bit that I had been duly admitted to their ranks."

ALL this is really merely a preamble to my subject, Walter C. Teagle—a preamble which seeks to emphasize among other things, that the oil industry viewed from almost any standpoint is a hard school through which a few persistent, industrious, and tactful persons succeed in fending away the obstacles and make their way to the top. No more striking example of such a forceful character can be found than in the personality of Walter Teagle.

Now president of the Standard Oil Company (New Jersey)—the old parent company operating the world over before the dissolution of the Standard Oil family and still the largest of the separate units that were once united under the Rockefeller aegis—Teagle was one of the discoveries of the War. Although then a long time employee entirely familiar with the manifold phases of the oil business—delivering kerosene in tank wagons to distant points, firing stills, erecting an oil-drill, or settling the grievances of some dissatisfied dealer—he was not prominently identified with the Standard until the entry of the United States into the world conflict suddenly threw an apparently impossible burden on the American oil industry.

In 1914 when the German Army crossed into Belgium, Teagle happened to be in Europe. He immediately started for Canada to reorganize the Imperial Oil Company, of which he was president, so that it could handle the tremendous load he knew would be put on it by the mother country. In three years he transformed a relatively small and unimportant refining and marketing company into a huge, integrated concern, ranking second among the industries of the Dominion. Some idea of the magnitude of this change can be realized when it is stated that within three years the capacities of his refineries had been increased from four million barrels of oil annually to twenty million.

Three years later, when the United States joined forces with the Allies, a similar problem developed in the entire American industry. The Standard Oil Company (New Jersey) promptly worked out a realignment to cope with the vastly increased responsibilities imposed on it by the War. A. C. Bedford, who was then president, was freed from actual operating duties by being made chairman of the board, and in his place a younger man was sought to speed up production and overseas transportation. The directors at once turned to the Canadian subsidiary and called Teagle to the presidency of the parent company.

Mr. Teagle, who was born in Cleveland on May 1, 1878, comes from

a family long associated with the oil industry. His mother's father, Maurice B. Clark, was one of John D. Rockefeller's first partners, while his father, John Teagle, was head of a well-known oil firm—Scofield, Schurmer, and Teagle.

He entered Cornell University in 1896, specializing in chemical engineering, and was graduated in 1899. During that time he managed two school publications, was an assistant manager of the football team, a member of the Alpha Delta Phi fraternity, besides taking part in numerous other college activities. After graduation he was offered a teaching position at Cornell. Before accepting young Teagle returned to Cleveland to confer with his father about it. The latter had other ideas, and instead of teaching at Cornell young Teagle went to work firing stills at twenty-nine cents an hour.

For two years he worked in his father's refinery, and in 1901, when the Scofield, Schurmer, and Teagle business was sold to the Rockefeller interests, twenty-three year old Walter Teagle was placed in active charge. Two years later, in 1903, he accepted a position on the export committee of the Standard Oil, and for the next few years the larger portion of his time was spent abroad, in Europe, South America, South Africa, and the Dutch East Indies. In 1910 he was made a director of the parent company, and a year later was elected president of the Imperial Oil Company of Canada.

MR. TEAGLE is unusually large physically, as well as mentally, and it is said he feels a little finely drawn when he gets down to 225 pounds, but he carries his weight on a huge frame. He is as thorough a sportsman as he is an oil man, and spends every available vacation hour with gun and dogs or with fishing tackle. He is without doubt the most outstanding figure in the petroleum industry of the world.

His fifteen years in New York have been marked by a rapid expansion in the size and activities of the Standard Oil Company of New Jersey, until now its employees number more than one hundred thousand. It operates 147 tank ships, thus making it the owner of probably the largest merchant fleet in the world; and it has refineries located not only in the United States, but also in Canada, Cuba, Trinidad, Argentina, Colombia, Peru, Venezuela, Italy, Poland, Roumania, England, and the Dutch East Indies.

Mr. Teagle is in his office every morning about nine o'clock, and in the afternoon takes the 5:24 train to his home in Port Chester, N. Y. During this trip home the time is usually spent playing contract bridge,

a game of which he is very fond. After dinner, which is generally about seven, he pulls out a bundle of papers, brought home from the office, and works until eleven. Rarely does he read any of the popular books or magazines, never attends the movies, and goes to the theater only a few times during the year. To get him out to a party, banquet, or similar gathering is indeed unusual.

It seems that Teagle belongs to that small group of men to whom retirement, though entirely possible, is always something of a dream which is to take place some time in the future. It is said that on one occasion, when he asked when he intended to retire, he replied that he had expected to do so when he reached forty; at that time, however, the War came along and he could not quit in the middle of war, so extended the time ten years. At fifty he was too busy, and now at fifty-four he is still wishing he could take a vacation for the rest of his life.

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What Shall We Advise?

By Martin V. McGill

The duty of the chemical profession toward those who are interested in chemistry. A teacher discusses the problem of the coming generation.

DO YOU hear that knocking at the door? Weird, isn't it? Yet familiar. Wasn't it just a few days ago that you and I were knocking at that door? Funny, isn't it, that the chip is so slow to improve on the old block? But the chip in time becomes the block, and then the whole interest is in the block.

You wanted to be a doctor and I wanted to be a preacher, or was it a farmer? Just how was it, now, that you became a chemist? Kind of hazy? Perhaps some teacher, in love with his work and the ambitions of youth, inspired in you admiration and a desire to succeed in the field of chemistry. Or perhaps it was the lure of the test tube. No matter, though, you *are* a chemist. And now, what are we going to say to the crowd just outside the door earnestly calling, "Shall I be a chemist?" "What shall I be?"

Shall we open that door? No. They have a right to ask these questions and we are under obligation to give satisfying answers, for they will not be content with mere generalities. So, let's leave the door closed a little longer until—well, there seem to be some doubts to clear up first.

It is hard to realize there are still those who feel that, since the old wood pile was good enough for them, it is good enough for their sons, or rather, for other men's sons. This year I have seen some wood piles revived and some sons really working on them. But however beneficial such employment may be physically, I do not hear great commendation for the economic situation that makes it necessary.

Nor do some feel that the organizations for youth (substitutes for the wood pile), commendable as they are, really meet the situation. This is not through lack of purpose, aim, or plan of organization, but rather because the youth, trained in the organization and grown to manhood, fails to accept leadership over the youth of the next generation, so absorbed is he in his own round of business and pleasure.

WHAT was that whisper? Is the youth of America imbued with too great a love of the game and too great a desire for sport? Is there a limit to the stress that ought to be placed on sport when men face more leisure time than ever? Are we creating in the mind of youth the idea that life is play, only to have them find that youth soon slips away and, lacking a real foundation for life, they have a philosophy which makes work a drudgery?

> "Hard? Well, what of that?
> Did'st fancy life one summer's holiday
> With lessons none to learn and naught to do but play?
> Go! get thee to thy task
> And conquer or die."

But have we brought up unhealthful situations or simply situations that lack adjustment to the vocational needs of our youth?

Just now some one steps up with the complaint, "John is not getting any foundation for life from his school curriculum." Wait a minute. What does John want to be? Hasn't any idea? Nothing to work for! Why should he make an effort in school? How can we make him see a future use for this or that subject? There are many "Johns."

And another: "Do you know Robert cannot read, and he's in high school? It takes him five minutes to read a printed page, and when finished, he has no idea of what it is all about. Why can't Robert read?"

And there is an opposite. Frank is exceptionally brilliant, learns quickly and understands readily, but absorbs very little. Are the classes adjusted to him? Can he be made to understand that he should not only get but master the fundamentals in high school?

Ted is interested in sports. Lessons are a drudgery in his young life. He feels there will be plenty of time to work when he is too old to play. What is his need? How can he be taught a different philosophy?

There are more complaints, but these are enough. It seems that something definite should be done for these youngsters; and when their interest is apparently in chemistry, it is chemists who should present the data on that profession.

I wonder what these beginners really want to know? Let's listen at the keyhole. When we find out what they are talking about, maybe we can tell them something to the point.

And so we hear: "I've been set on being a doctor, but the other day Dr. Brown told us that if we didn't have several thousand dollars in sight, we'd better not consider medicine. That is the only career I'm interested in, but how can Dad send me through school when there are four other boys in the family to educate? I wonder if that doctor was right after all?"

Listen to the next: "You know, I could work at chemistry from morning till night, but how I hate that English and foreign language requirement. Why should I waste my time on them when I get such a big kick out of chemistry?"

And another: "Professor Jones told me the other day that I might as well give up the idea of being anything more than a routine chemist, because I was too lazy to get a math foundation. Boy, did he pan me about my math grades! Seems like I know enough math to get by all the chemistry we're having."

There's another who voices the question of thousands: "Say, Bob, they tell a fellow he needs a good college education to get anywhere in chemistry. How am I going to get the dough to go? And where can I go? But I guess there are some places you can work your way through—or why not stay out of school a year and work? My trouble is I don't know what college to pick, for you know, I do like a good time."

And still one more: "Wonder how long I'll have to go to school to be a chemist?"

WE CERTAINLY found out they are interested in more than how much money they are going to make. Now with these as examples of what they want to know, let us prepare a list of questions for which we think they ought to have answers. Then we shall be ready to open the door.

1. What things are fundamental in the grade and secondary preparation of the person who aspires to be a chemist? If he does not care to read or cannot read with understanding, what shall he do to correct his deficiency? How much aptitude for mathematics must a chemist have?

2. Has a sense of responsibility been developed in the doing of small tasks so that full responsibility can be assumed when opportunity comes?

3. In what ways can a boy interested primarily in chemistry, but grouped with many not chemistry-minded, supplement his academic work in chemistry?

4. For whom shall the training given in the arts college be recommended and for whom the more specialized courses of the technical school?

5. How can a plea for open-mindedness versus tight-mindedness best be brought before the youth anticipating chemistry as a career?

6. What are the personal qualifications that the chemist must present? Who shall be advised definitely to look elsewhere than chemistry for a vocation?

7. What data should be presented to show that the field is overcrowded and that the aspiring chemist must possess many qualifications if he is to be more than just a pawn on the chess board of some organization? What particular characteristics does a chemist need?

8. What recommendations shall be made as to choice of institution of higher learning, and what shall be the basis for such recommendation?

9. What opportunities are there for the boy with an enthusiasm for chemistry and with a very limited source of revenue?

You who read this will think of many other appropriate and fundamental questions. Let us consider our answers and then let us open the door to the thousands of boys and girls who are interested as we are in chemistry.

You will not answer their questions as I shall, but at the start let us tell those who come in confidence to us for advice, "My son, it may be advice I am giving you, but I would much rather you listen with an open mind, getting as clearly as possible the meaning of my suggestions and those of your friends, then in silent communion with your own self, choose that which to you seems most adapted to your talents, your pocketbook, and your future happiness."

BY-PRODUCTS

Speechmaking

THERE has been an unaccountable decline in the good old-fashioned art of speechmaking. The waning of this indoor sport is evident not only in the form and substance of the speeches but in the impatience of the audiences. No longer does the prospect of hearing a long, carefully prepared address appeal to the diner. He urges a two-minute speech at the longest and will not grant more time for any but some audacious comedian. Entertainment always—erudition never! Even the speaker with a serious message feels it necessary to flavor his speech with humor to gain a hearing, and too often his attempt to be entertaining suggests the picture of an elephant toe-dancing.

We no longer dine, we feed. Why? Can the hydration of the venerable constitution be the reason? Has our sobriety made us more critical and less tolerant, or do we lack certain anesthetic influences available to our grandfathers? *In vino veritas, aqua vanitas!*

Diary of a Prize-winner

MARCH 1st, 9:09 P. M.—Wonderful news! Heard over radio I have won grand prize of $10,000 in Ueatem Consolidated Baking Company contest. Will now be able to buy new hat....

9:10.—Interrupted by long distance from gentleman who wants to interest me in Pasadena real estate. Hung up.

9:20.—Herrick called up to remind me of ten bucks I borrowed from him a year ago. Guess I'll pay him.

9:22.—Two life-insurance agents just forced their way in. They travel in pairs now, like cops in a tough district. Made themselves comfortable, as if for a long stay.

9:31.—Bond salesman, "just going by," drops in for a visit. Hands me a cigar. Introduced him to the life-insurance agents. Thinks they are relatives. Didn't hand them any cigars.

9:45.—Auto dealer has joined happy throng. Has a wonderful proposition on a $5000 car, "practically pays for itself." Introduced him to the bond salesman. Insurance men still here, not so optimistic.

9:46.—Feminine voice—middle aged—over 'phone. Begs donation

to home for hopeless hopheads. Put the auto dealer on the wire... said it was his wife. Apologies later..."my mistake."

9:48.—Rival insurance agent arrives. May manage something in the Kilkenny cat line with the other agents. All talking at once. Din prodigious. Each one thinks I'm figuring on his proposition while writing this.

9:51.—Business broker comes in. Lock on front door broken. Wants to sell me partnership in delicatessen. Don't know roquefort from salami. "Man with your business ability can make millions... chain store expansion, etc., etc...." "Twenty-five miles on a gallon, liberal wheeling, single shot lubrication...guarantee 7% absolutely safe, gilt edged...and at the age of 67½...absolute protection for yourself and family...day's receipt often over $150"—or is that the insurance premium?

10:02.—"Broadwold" developer gets here. Wants me to possess very choice lots...bound to quadruple in value by next year...city moving right up to "Broadwold" (25 miles out). Introduced him to life insurance men.

10:15.—Second auto dealer rushes in. Handles $2000 class. Just getting his sales-talk going when traffic cop enters. Arrests second A. S. for doing 50 m. p. h. across town. Offered him the rest of the salesmen at a nominal figure...couldn't close deal. Exit law and disorder, in part.

10:29.—Salesman for iceless refrigerator. Meets frigid reception.

10:29½.—Agent for fruit trees and shrubbery. Introduce him to "Broadwold" developer, explaining need for landscaping.

10:31.—Breeder of fancy dogs. Seems I need a Great Dane and a Scotty. Hadn't occurred to me. All salesmen now talking at once. Sounds like a convention, or a radio party.

10:47.—'Phone rings. Bond salesman got there first...says, "No, he's out of town"...hangs up. Thanx.

10:59.—Contractor and builder...plans for 12-room house...."Can't be beat for the price...dirt cheap...materials and labor low...now the time to build." Sicked him on the refrigerator man.

11:15.—Radio salesman...smallish man. Threw him out the door. The radio has caused me enough trouble.

12:15 A. M.—Hail! The gang's still here. Everyone yelling in effort to drown the others. Chairs all gone...four standing. Beginning to feel groggy. Speculating about turning in fire alarm.

12:20.—Tailor's agent. "Niftig sueits for Spring wear." Takes my

measurements with one hand and riffles his cloth samples with the other, talking incessantly the while.

2:45.—Party just getting going. Cigarette and cigar stubs all over rug. I'm nearing the count. Dapper saphead arrives from New York by plane... has contract for indorsement of "Plucky Brights" cigarettes. This is the last straw. I'm going to take desperate measures! I can stand no more.

2:48.—Fought my way to 'phone. Called up Ueatem Consolidated Baking Company. Got executive out of bed... three of them. Positively refused to accept prize. Said it would put me in the surtax group... cost more than it is worth.

2:49.—Salesmen all left hurriedly... and profanely. And so to bed. Never again!

War and Democracy

"IF WE recall that democracies wage ever fewer wars, the thesis that war is a great democratizing agent is likely to seem self-contradictory," began the philosophical Biologist recently.

"The usual idea," we suggested, "is that, on the contrary, war developed monarchies."

"Reference to historical facts," continued the Biologist, serenely, "demonstrates that while war originally was an individual concern, a duellum, it rapidly became a tribal affair, a bellum. The mighty warrior became the leader, then the chief, and finally the king. Since he derived his leadership from war, he had to wage war to preserve it. So far war did develop monarchies.

"Monarchies evolve into aristocracies; and at a period not so remote, the aristocracies initiated and controlled all wars, while the plebeians fought them and died in them. The aristocrat was comparatively safe. He had a high survival probability. In the Middle Ages the armorial equipment of the knight was beyond the means of any but the rich, even if the commoner would have been permitted to wear it. With the offensive weapons available at that time, the suit of armor furnished nearly ideal protection. Added to that was the custom of sparing fallen knights for the sake of ransom. War was a gentleman's pastime. It was serious business only to the ill-protected plebeian.

"It is commonly stated that the introduction of better weapons, especially gunpowder, rang the death-knell of chivalry, and this is partly true. It is more important, however, that the discarding of armor gradually reduced all fighting men to a common level. There the manly

virtues and intelligence are the characteristics that determine command and control."

"Are you deducing democracy from intelligence or manly virtues?" we asked, stimulatingly.

"Perhaps," he laughed, "but I'm not going to allow you an opportunity to ask what biology has to say about either one! The important fact here is that the mass of humanity finally reached the conviction that battles are won by brains rather than by pedigrees; and brains may occur in the heads of untitled nonentities, and sometimes do!"

"There were republics in Italy during the Middle Ages," we observed.

"And the aristocracies controlled them," he replied. "The Swiss republic, however, lacking an aristocracy, has been a democracy since it wrested its freedom from Austria, and has fought few wars since."

"So, if we take the profit out of war, we shall eventually eliminate armed conflict altogether?" This struck us as a brilliant idea, but the Biologist shook his head.

"Do you wish to argue that men always act in accordance with their best interests?"

—*The Autocratic Chemist*

A Sabbatical Year for the Industrial Chemist

By H. G. Lindwall

A chemistry professor suggests a plan for increasing the value of the industrial chemist. Do industrialists have enough opportunity for mental expansion?

IN MOST universities, the professors are allowed every seventh year as a "sabbatical year." The name, we hope, is somewhat of a misnomer. In most cases the year is not one of rest alone, but is spent in retrospection and in research. The sabbatical year is a period of release from the monotony of teaching things to undergraduates. It provides for real advance in individual knowledge and for broadening of the horizon. A properly spent sabbatical year accomplishes these

things. The responsibility is the individual's, for a lazy person can easily develop his laziness if he sees fit.

Admittedly, the industrial chemist has not the leisure of the college professor. Leisure is part of the professor's pay. The currency handed the industrial chemist is of another kind, and few companies feel that much leisure should accompany it "to boot." A busy, bustling laboratory is a sign of money's worth for the employer, according to usual standards. Work is turned out, salable products are developed, and the wheels turn.

Even in the research laboratories of the companies with vision, money is the prime concern. Whether it is admitted or not, the purest of industrial research is carried on in the definite expectation of having something to sell some day. Interesting phenomena are often observed, in the course of an investigation, which would set an academic group agog. The industrial researcher must ignore it as "having no bearing on the problem at hand." Many interesting hints of new things must be left to the files—often the graveyard of ideas.

Too, the industrial chemist, unless he happens to occupy a most enviable position, usually has little time to keep up to date with recent developments in general chemistry. He must keep up to the minute in the chemical developments of his field of products, but his knowledge does not grow beyond those narrow confines. Most organic chemists know the physical chemistry they knew at graduation, minus what they have forgotten, and vice versa for the physical chemists. The average industrial chemist, staying with the same company for years, is likely to know "more and more about less and less."

WHERE does the employer fit into this picture? He, of course, is the man who wins or loses depending upon the work and inspiration of his research men. If his chemists are unable to make application of new ideas from other fields to the production of his products, the employer loses. If the research men of the organization are on their toes, looking for new things, able to understand new things, and able to apply new ideas to old methods, the employer wins. In other words, it pays the employer to have good, up-to-date chemists in his employ.

And how can an industrial chemist stay up to date in his general knowledge? Why not by means of a sabbatical year? Let us imagine such a Utopian situation.

The chemist chosen to enjoy the benefits of a sabbatical year would be allowed a considerable amount of freedom. He would be chosen on the

basis of ability, imagination, and dependability. He would be a man who can carry on independent research with persistence and care. In general, he must be a real lover of knowledge and essentially a practical man. He would leave his laboratory and go perhaps to some university of good repute to work there on the problems that have confronted him during his years of intensive and usually hurried work in the industries. A good man will think of plenty of problems. Probably his chief task will be to choose one from the large number. With due respect to his employer's pocketbook, he should select a problem of general interest to the industry with which he is connected, but the problem should be one of a fundamental nature.

In addition to his research work at the university our chemist would emphasize the question of acquiring general information through reading and through conversation with research workers in fields of pure science. He should especially be on the look-out for new facts which might help in the research problems of his own company. There is many a slip 'twixt test tube and factory, but many of the slips are the result of insufficient imagination to see the practical possibilities of the results obtained by the pure science workers. Obviously a man fresh from industrial work should be in a position to spot important applications which might otherwise wait for years before being unearthed.

THE advantages to the chemist of a sabbatical year are apparent. The year of study and thought will make him a better chemist, worth more to his employer. Conversely, the employer will be benefited in having a man return to him with a wider scope of ideas and with thoughts on how to put them into use.

Of course, the whole thing is up to the employer. He may hesitate to pay a salary to a man for work which is not immediately productive; but if he considers the system as a form of insurance against being submerged by some firm with greater foresight, he may give the idea some thought.

A Versatile Woman Chemist

By A. P. Sachs

The story of Florence E. Wall, with some of the factors that have made her success possible. An appraisal by a fellow-chemist.

THERE are many biographical formulae for the modern biographer to use—the Lytton Strachey, the Emil Ludwig, and some others not so best-sellingly desirable at present. One of the principal ingredients of a biography seems to be a suitable subject, a Washington, a Pasteur, or a Lord Byron. Of course, most people, real or imaginary, are not Washingtons just as most chemists are not Pasteurs. The influences which shape the destinies of genius can hardly be of great importance in the lives of those this side of genius.

I have always wanted to know how successful men and women achieve those modest successes which are the mortal rewards of those who experience neither the great tragedies nor the great joy of genius. I have wanted to know how Prof. K——who is the competent head of the department of chemistry of one of our lesser colleges attained the modest eminence which he possesses and how Dr. F——the chief chemist of a small laboratory achieved the relatively minor worldly success which he so fully enjoys. What distinguishes these people who achieve position in their own immediate group, a local, national, and possibly even a modest international success in their professional group, people who do not set the Thames afire and yet are respected and admired by their associates and friends as successful people? Are their virtues apparent in youth or do their successes accrue by the orderly slow processes of seniority, favoritism, and nepotism combined with helpful strokes of good fortune?

MISS FLORENCE E. WALL is a chemist whose experience in recent years has been in the field of cosmetics and beauty culture. She is highly esteemed professionally by her colleagues, enjoying a reputation which is more than nation-wide for it has carried her name to Great Britain and the continent. We have as our subject a personality who has admittedly achieved success, acquired repute and the emoluments which belong to reputation and success. She should make an interesting biographical study; she does.

Born nearly forty years ago in Paterson, N. J., a city famous for its chemical and textile industries, the young Florence became a ringleader of the mischievous youngsters of the vicinity. The tale of her childish pranks and hoaxes (as related by a still admiring sister) is full of ingenuity and imaginativeness. Her parents were cultured and made sure that their children acquired a good education. She remembers her father as a delightful companion who interested her in everything—music, art, and good reading, but especially in etymology, which undoubtedly laid the foundation for her remarkable ability in languages, domestic and foreign, and in chemistry, which she finally chose as her major subject at college.

Miss Wall was educated at the Academy and College of St. Elizabeth at Morristown, N. J., and her educational record is remarkable for the amount of it she was able to put to practical use in her later career. In addition to the four standard courses in chemistry, she studied radioactivity (rare indeed in 1912!), physiological chemistry, and history of chemistry. Always interested in writing, she won prizes for short stories and essays, wrote a play that was presented by the college dramatic association in her junior year, and was editor of the college paper in her senior year.

It seems almost too much to add that such a girl could also have found time to acquire a thorough education in music, and complete an approved course of training for teachers; but she did, and finally, in 1913, at the age of twenty, she was graduated with the baccalaureate degrees of Arts and the Science of Education.

Miss Wall first taught for several years; in 1913 there was little else a scientifically trained woman could do. The teaching was catholic in its scope: chemistry, physics, the biological sciences, and English. Evidently our fellow-chemist is an excellent instructor. Her former principals say so, her present technical literary work is evidence of it.

The Great War broke out. With it came opportunities not only for men but possibly even to a greater degree for women. In 1917 Miss Wall entered the service of the Radium Luminous Material Corporation

where she first did general analytical work on the ores and later carried out the exacting electroscopic determination of the radium for medicinal and commercial use. The danger in this work was not sufficiently understood at the time and a number of fatalities have resulted, but she seems to have escaped unscathed.

Between 1918 and 1921 Miss Wall was employed by the Seydel Manufacturing Company, the Fellows Medical Manufacturing Company, and Ricketts & Co., in analytical and research work in such varied fields as soaps, sizings, dyes, pharmaceuticals, airplane dopes, essential oils, glycerine, metallurgical analysis, petroleum, and others. Her "good nose for research," her creative and executive ability, and her absolute dependability soon won her an enviable reputation. Her last problem at this time was the complete investigation of a proposed oil-cracking process, including patent searching and reports, the design of apparatus, and testing the process on the experimental plant scale. It was strictly confidential work carried out entirely by Miss Wall without supervision; and many were the thrilling episodes of promising high yields that could not be duplicated while this keen-eyed chemist was present, and of mysterious accidents staged by the frustrated temperamental inventor.

IN 1921 when many others had to make sudden changes, Miss Wall went to Europe for a year of travel and study. She returned in 1922 to find conditions even worse but since science teaching or chemical work was not to be had she cast about to utilize some of her other talents. Hearing that there were good opportunities for American teachers in Havana, she packed right up and soon took in hand the complete education ("everything including music") of a young Cuban girl. The problem was quite unique, and even a casual recital of how she solved it does credit again to her creative ability—this time in the science of pedagogy.

This episode also gave her what too few of us ever get—a chance to review everything we ever knew and bring it up to date. But after two years she was longing for chemical work again so she returned to the United States in 1924 by way of a trip around South America.

But all this was merely preparation, good, substantial preparation for the work which was to bring her the success and reputation which justify the present biography. She soon entered the employ of Inecto, Inc., the largest manufacturers of hair dyes and other hair preparations in the country. This gave her an entry into the field of beauty culture.

She found that the knowledge of cosmetics and beauty culture was

empirical, faltering, and permeated with considerable elements of inherited charlatanism. It was considered at least slightly shady for chemists of either sex to have any contact with this branch of, shall we say provisionally, esthetics. This shadiness was due, at least partly, to the fact that the use of cosmetics had been considered a moral question whereas actually the use of cosmetics is merely the application of the restorative art. It were as wise to say that petroleum chemistry is immoral because crimes and immorality have been abetted by the use of gasoline as to say that cosmetic chemists are drenched with the odor of immorality because certain people of questionable reputation have used cosmetics liberally. The bright sun shines equally on the just and the unjust, and it may fairly be assumed that the benefits of cosmetics and beauty culture similarly come to both the just and the unjust.

WITHIN her first year of practical experience Miss Wall established a department of technical advice for her employers, and collected enough basic scientific information for a book. She called it "Canitics" which she defined as the composite art and science of correcting *canities* (medical jargon for *gray hair*). She then established and became director of an institute that the company founded to give some semblance of professional training to the practitioners of the art of hair dyeing.

From hair preparations to cosmetics and treatments for the skin was a step easily taken. Her teaching ability and experience, her broad chemical knowledge, her interest in beauty culture, and her feminine viewpoint led her inevitably to the field of technical publicity in her chosen sphere. As her reputation grew, numerous calls came for written articles in various periodicals and for lectures to all classes. In 1928, sensing a real need for a reliable, independent source of information on all these former mysteries, she became a free lance by choice and soon afterward went abroad again to study the beauty culture and cosmetic business in Europe from every possible angle. Wherever she went she gave almost more than she took away, and today Miss Wall is internationally known as an articulate authority on beauty culture and as a gifted and informed publicist. Her latest book has coördinated all the contributory branches of related technical knowledge into the creation of another science, that of professional beauty culture, for which with characteristic ingenuity she has invented the name of "beautistry."

THIS chemist never took any higher degrees. Fortuitous circumstances deflected her at different times from a master's degree, and from chemical engineering; and she still regards her frustrated plans to

enter medical college as a miraculous escape. Her herculean effort to elevate a nondescript trade to something like professional standing has been her post-graduate work.

But she never stopped studying. A new language as a preparation for invading some unknown country; courses in advertising typography, and in merchandising and marketing to help her work in technical publicity; anatomy, dermitology, phototherapy, and cosmetic chemistry. That she might tell others how to sell cosmetics, she actually worked behind the counter for a while in one of the largest New York stores.

Like most successful people she has vast resources of energy and great powers of concentration; unlike many geniuses she has a fine sense of humor which helps her over many business and professional bumps and permeates her social life.

For two years Miss Wall edited *The* CHEMIST practically single-handed. Her knowledge of chemistry, her editorial ability, her knowledge of typography and layout and her interest in the Institute made the difficult task seem easy in her hands. Her issue for April, 1931, commemorating the medal award to the Mellon brothers has been acclaimed "the finest exposition of what the Mellon Institute is and does and the greatest tribute to these great industrial giants that has ever appeared."

Miss Wall, besides being a fellow of the Institute, is a member of the American Chemical Society, the Society of Medical Jurisprudence, the Authors' League, and the League of Advertising Women. Since she became a fellow of the Institute in 1923 her interest and activity have been displayed unremittingly.

MISS WALL runs her own domestic establishment, of which she is the sole member. She has an ingratiating way of inviting one occasionally to "come over Sunday morning for brunch." There is competent testimony that the Wall omelets, waffles, or griddle cakes, and coffee are a credit alike to her chemical training and domestic talents. To round off the brunch the lucky guest always finds his favorite cigarettes or Havana cigars at hand.

She has a fine collection of old and rare books on alchemy, chemistry, pharmacy, medicine, witchcraft, and cosmetic arts and practices, and if she reaches for one to read a paragraph on something or other it seems to make no difference whether the book is in Latin, French, German, Italian, Spanish, Portuguese, or Flemish. She is much interested in world affairs, foreign trade, etc.; yet she sometimes lets newspapers accumulate for weeks unread. She used to play tennis and basketball and still likes to dance and ride horseback; and most re-

cently she tried out fencing. She does not care for bridge or golf because she has never had time to learn to do them well. There are all sorts of modern labor-saving devices around the house, and no radio; but she still makes of her piano a hand-played musical instrument instead of merely a household ornament.

Miss Wall loves to travel, occasionally with a congenial companion, preferably alone, because she says she can get more of the atmosphere of a place that way. The mere fact that "nobody goes there" is usually enough to make her buy a ticket. There are many stories: of jailing pickpockets in Rome, just escaping jail in Austria, a friendly haggle with a Lapp over a carved reindeer horn, or with a grizzled Moorish linen vendor in Tetuan—or a chat with a taxi driver in the Hofbräuhaus. One seems quite characteristic: when, on her trip to South America, her companion persuaded her to give up a side trip to Quito, she confessed months later that her reason for wishing to go was that when she was fourteen she had learned in physics class that water boils there at 90° and she wanted to see it.

IF ONE asks Miss Wall why she does not write up some of her interesting travel adventures, she says, "They'll keep until I look too old to talk convincingly about beauty culture." She actually does believe sincerely in her work. Her pet remark there is that, "Any woman has the right to resort to any legitimate means to improve her appearance, but she should learn to do it inconspicuously." She admits freely that she employs a whole battery of cosmetic ammunition herself, but the result is a tribute to her knowledge of the artistic application of the science of beautistry.

When the photograph at the beginning of this article was first published it bore the caption, "Why is the lady's smile like the Mona Lisa's? Perhaps because after grubbing around in chemical plants and laboratories for many years she has emerged as a world authority on beauty culture."

Is this success, this apparently gradual growth to a certain stature the result of mere chance? Or is it not rather the inevitable product of a distinct native gift compounded of ability, ingenuity, and imaginative power mingled with due proportions of will power, application, and diligence, all brought to bear on a problem possessing inherent potentialities of bringing reputation and success to one who would have the vision to attempt to solve it?

The New Chemistry of the New Russia

By Lily Bell Deatrick

An American chemist gives her impression of the principles underlying the chemical policies of the U.S.S.R. Chemistry for the people.

OVER the door of the University of Moscow are these words: "Science—For the Toilers." And this legend—unlike most of the legends graven on college buildings—means exactly what it says for if the Soviet government is not "of the people" and "by the people" it certainly is "for the people," and nowhere is this made more evident than at the entrance to the higher institutions of learning. The sons of Martha—short of stature, grim of jaw—go in first, filling up the classroom and laboratories, while Mary's sons—heirs of classic culture and scientific lore—cool their heels on the outside waiting their turn.

This policy may not be a good one but there is much more reason for it than is apparent on the surface. It is not merely a vindictive gesture on the part of Soviets—and it is much more than an application of the "victor and spoils" principle, although there is something of that in it. It is the logical outcome of the short-sightedness of a government that legislated for only a few per cent of the governed. There is simply not room enough for all the students who want to enter. Until there is, the erstwhile ruling class, that has had its chance, must stand aside.

THE first fruits of such a course will undoubtedly leave much to be desired. It is a long step from a crooked-stick plow to a chain-o-matic balance, and this generation may not be able to take it. One chemistry teacher in Leningrad voiced the secret feeling of many, I suspect, when he remarked, "Silk purses out of sows ears'—that is easy, but to put a barrel of knowledge in a pint measure—that is going to take time!"

This must be said, however, what the new type of student lacks in background and training he makes up for in eagerness and hard work. We visited a Scientific Institute near Skarsalac. I nosed around till I found a chemistry laboratory, and I was amazed at the spirit of the place.

Given bleachers and a few chrysanthemum vendors it would have passed for a football stadium on Thanksgiving afternoon. I had more confidence in the fulfilment of the Five-Year Plan after I saw that roomful of students at work.

MUCH has been written concerning the ill treatment by the Soviets of university teachers in general and of science teachers in particular. One of the best known of our own American chemists spoke bitterly about John Dewey's favorable report on Russia a few years ago and based his criticism on the fact that the Russian government was "persecuting" many scientists. He was a member of the same group with which Mr. Dewey visited Russia, but I took his testimony with a grain of salt for he is, from the top of his crisp white hair to the tip of his custom-made shoes, a *bon vivant* and might be expected to interpret poorly cooked meals and coarse clothes as personal insults, and proletariat classes as an attack on professional dignity.

It goes without saying that the government is more interested in chemistry than in chemists; but even so, I could find no evidence of persecution. Living conditions over there are hard for anyone accustomed to the twentieth century refinements of life, and there certainly is no freedom of speech as regards the theory or practice of the present government; but such hardships are general and in part inevitable—not the peculiar fate of the intelligentsia.

There is one striking difference between the chemistry of the old Russia and that of the New: the former was almost wholly theoretical, the latter has a strong pragmatic flavor. The character of chemistry prior to 1917 was not a matter of choice in the laboratories. It was determined by a governmental edict—none the less effective because it was unwritten. With characteristic stupid, and perhaps unconscious, selfishness the Romanoff rule withheld support from any piece of work that looked toward the direct benefit of the masses. This was particularly true of chemical work in agriculture. The result is that Russian soil chemists, the finest in the world along theoretical lines, are just beginning to make practical applications. It is quite significant that Russia imports engineers—chemical engineers, agricultural engineers, economic engineers—rather than pure scholars, quite logical that when she sends over students to be trained in the United States she stipulates that they go to professional schools. There are some sixty of them now scattered through Massachusetts Institute of Technology, Lehigh, University of Wisconsin, and Case School of Applied Science.

THE chemist in Russia is an integral part of his government. His findings are accepted, his recommendations acted upon without delay—there is no playing political football with subject of his investigation after he has made his report. And the field for chemical activity is enormous. New mineral deposits are being located faster than their products can be worked up. The great bog-areas of the north central region are potentially rich sources of food supply. The waste of the forest lands is raw material for a dozen new industries; and the needs of a hundred and fifty million people, just waking to the possibilities of decent living, present a challenge to every laboratory in the land.

Positions Wanted

The following chemists are available for positions. Further information will be furnished upon application to the American Institute of Chemists, 233 Broadway, New York, N. Y.

101-XX	Chemist experienced in analysis of metals, rubber, paper. Some research experience.
101-QT	Ph.D. with wide experience in food products. Head of laboratories of various canning companies.
101-PQ	Chemistry professor. 15 years' teaching experience.
101-IN	Chemical engineer experienced in high vacuum and the chemistry of air gases.
101-ZN	Research and plant chemist experienced in cement, leather, high explosives, acids, fertilizers.
101-MO	Research chemist experienced in explosives, dye intermediates, acids.
101-HW	Paper chemist, research and development work.
101-DP	Recent graduate, industrial position.
101-ID	Chemical engineer, nine years' experience plant work and management.
111-NQ	Chemist, 11 years' experience. Research, analysis of metals.
111-OX	Organic chemist, experienced as chief chemist and director of research.

OUR AUTHORS

Chemistry and the Standard Oil

James B. Rather was born in Texas in 1888, and was graduated from the Agricultural and Mechanical College of Texas in 1907. He did post-graduate work at this college, at Chicago, and at Johns Hopkins.

Since 1919 Mr. Rather has been in charge of the general laboratories of the Standard Oil Company of New York. A member of the American Chemical Society and of a number of other technical societies and organizations, he has published some 35 articles on various phases of chemistry. He is the patentee of testing apparatus and of refinery processes relating to the petroleum industry.

Economic Prospects of Chemists in Medicine

John M. Ort, F.A.I.C., Ph.D. (Ohio State), was trained originally as a chemical engineer. He taught general, analytical, and physical chemistry for five years, during which time he became interested in the colloid and physical chemistry of living organisms.

For the last eight years Dr. Ort has been on the research faculty of the Mayo Clinic and Mayo Foundation. His official designation is biophysicist, but his research work and publications are all in the field of physical and colloid chemistry and their applications to physiology.

Dr. Ort's hobbies are fishing and bridge.

Chemistry Teacher

Martin V. McGill was graduated from Michigan State College in 1914. He has devoted his time since then to teaching in high schools and is now guidance director of Lorain High Schools.

Interested in education, Mr. McGill finds the problems of high school teaching very absorbing. A past vice-chairman of the Division of Chemical Education of the A. C. S., he is chairman of two division committees, on Visual Aids in Chemistry and on Vocational Guidance in Chemistry. He is a past-president of the Ohio State Chemistry Teachers' Association, and helped organize a similar organization in northeastern Ohio.

Mr. McGill is a joint author with G. M. Bradbury of two books: *Practice Exercise and Objective Test Book* and *Chemistry Work Book and Laboratory Guide.*

Mr. McGill's hobby is gardening, mostly because he likes to give people flowers.

Chemist and Writer

Albert Parsons Sachs, F.A.I.C., received his master's degree from Columbia just in time to become works superintendent for the Aetna Explosives Company in 1915–16, when explosives plants were running at a pitch of production which called for executives who could keep their heads. After the war he spent several years superintending research and directing plants. He went into business for himself as a consulting chemical engineer in 1921.

Interested in the profession, Mr. Sachs has long been a councilor of the Institute. He faithfully attends meetings, where he can always be counted upon for an original point of view.

Cosmopolitan and cultured, Mr. Sachs likes travel, also likes music, fine books. His chess library is one of the finest in the world. For exercise he plays tennis, and is good at it.

A literate chemist, Mr. Sachs is a contributor to many publications. He is a former editor of *The* CHEMIST.

Chemical Engineering at Princeton

Joseph C. Elgin, Ph.D. (Princeton), did his undergraduate and master's work at the University of Virginia, where he was a du Pont fellow. After taking his Ph.D. at Princeton, he spent two years as research fellow of the American Petroleum Institute, is now assistant professor of chemical engineering at Princeton.

He has also done consulting research and development, chiefly for the Thermoid Rubber Company.

Colleagues describe Dr. Elgin as quick, accurate, and thorough. He likes to play tennis and golf.

Chemical Warfare

C. G. Storm, Ph.D. (George Washington University), has been an explosives chemist for 31 years, with Aetna Explosives, Trojan Powder Company, Bureau of Mines, and the Navy Department. He was a lieutenant colonel with the Ordnance Department during the war.

and has been chief of the explosives section in the Ordnance Department for the last ten years, holding a commission as colonel in the Reserve Corps.

Thoughts on Unemployment

Charles H. Herty, F.A.I.C., is one of the best loved of American chemists, and is one to whom the human side of his fellow scientists is important. He feels keenly on the subject of chemical unemployment, and brings to his study of the question experience he gained as president of the American Chemical Society and as editor of *Industrial and Engineering Chemistry.*

We hardly need add that Dr. Herty is famous for his researches on the slash pine, and that he will receive the medal of The American Institute of Chemists at the Annual Meeting on May seventh.

Spokesman for the Engineers

John P. H. Perry is a Harvard man who took his degree in civil engineering. He is vice-president of the Turner Construction Company, and a past-president of the New York Section of the American Society of Civil Engineers.

Report on Unemployment

D. D. Jackson, F.A.I.C., has had varied educational experience. He was graduated from M. I. T. in 1893, then went to Harvard Medical school, still later to the graduate school of New York University. After experience in teaching and in research, microscopy, and bacteriology, he joined the faculty of Columbia, where he is now an executive officer and professor in the department of engineering. He is a particular expert on municipal water plants.

Dr. Jackson plays squash at the Columbia University Club, is also frequently seen at The Chemists' Club, of which he is vice-president.

Sabbatical Year

Harry G. Lindwall is a young Yale Ph.D. (1926), who spent two years with the du Pont Company and who is now assistant professor of chemistry at New York University.

A chemist with whom chemistry is a hobby as well as a profession, Dr. Lindwall's favorite pastime is research, though he also likes golf and motoring. His particular chemical field is oxindole and quinoline chemistry.

Teagle Biographer

Carleton Ellis, F.A.I.C., is a New Hampshire Yankee, and is, therefore, a born inventor. Soon after graduating from M. I. T. he invented a paint remover, the patent for which withstood much litigation, and which gave him a good start toward becoming one of the country's most successful chemists.

This first patent was followed by many others. Mr. Ellis' active mind took him from one chemical field to another, including the hydrogenation of oils and the development of catalysts. He is a recognized authority on hydrocarbons, particularly petroleum oils, and on such other synthetic processes as the manufacture of ammonia and ethyl alcohol.

Mr. Ellis has also developed a number of plastics; and he is the author of books on such widely separate subjects as *Synthetic Resins and Other Plastics,* and *Vital Factors of Foods: Vitamines and Nutrition.*

Athletically inclined, Mr. Ellis has his own squash court on his estate in Montclair.

Value of Research

Lawrence V. Redman, F.A.I.C., is a graduate of the University of Toronto, where he also did post-graduate work before going on to the University of Kansas, where he spent four years.

The inventor of redmanol and president of the Redmanol Company, he became an executive of the Bakelite Corporation when these two synthetic resin-companies merged. He is now vice-president in charge of research, feels strongly the importance of research in the economic scheme.

He enjoys philosophical discussion, enjoys still more living the life of a country gentleman on his considerable estate in New Jersey.

The New Chemistry in Russia

Lilly Bell Deatrick, Ph.D. (Ohio State), was formerly a chemist with the Bureau of Standards, is now associate professor of chemistry at the University of West Virginia.

Doctor Deatrick's chief hobby is collecting old Windsor chairs.

BOOK REVIEW

The New Conceptions of Matter. By C. G. DARWIN. *The Macmillan Company.* $3.00.

There could be no better review of this book than to reprint its introduction and to state that the aims there set forth have been achieved. The book is stated to be the reworking of material presented in a course of lectures delivered at the Lowell Institute of Boston in the spring of last year. Professor Darwin disclaims in his introduction any interest either in metaphysical speculation on the one hand or in "theological diagnosis" on the other. His object is solely to strip the "mathematical scaffolding" from the most recent theories of the structure of the universe and present "an intuitive view of what the world is really like."

Hence the book offers to the reader who is willing to take the effort, an opportunity to visualize as far as may be possible the paradoxical behavior of the ultimate elements of matter and energy in both of the aspects which modern "mathematical chemistry" requires to explain its data.

In separate chapters the reader will find developed with full precision of statement the basic principles of Superposition, Least Action, Uncertainty, and Exclusion by which the mathematicians have built up their formal equations of the nature of physical existence. In addition to precision of diction, the reader will find clarity and beauty of harmony which, in spite of the difficulty of conception, make the reading a pleasure.

Professor Darwin has used as his base the wave theory rather than the particle theory, partly because it is easier to visualize, partly because the deductive chain is easier to follow, and partly because only the ultimate paradox of waves coagulating into groups with corpuscular properties remains when the paradoxes which have beset atomic physics for a half century are explained away. The polarization of light, of electrons, and even of matter becomes explainable.

It should not be understood from the above that the particle theory has been at any point neglected. The particle theory is brought in each time that a point has been made and fitted to the structure, but the development is through the wave theory.

As indicated, the book is not easy reading, but any adult who reads it will find himself the gainer.

KARL M. HERSTEIN

INSTITUTE NOTES

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National Council

The eighty-ninth meeting of the Council of The American Institute of Chemists was held at The Chemists' Club, 52 East 41st Street, New York, N. Y., on Thursday, March 10, 1932. President Frederick E. Breithut presided.

The following councilors and officers were present:

Messrs. Cayo, Crossley, Harold, Herstein, Knight, Lynch, Moody, Neiman, Sachs, Zons. Mr. Edward L. Gordy, editor of *The* CHEMIST, was also present.

President Breithut stated that he would visit Buffalo on April 2, 1932, relative to the formation of a chapter in that city in accordance with the request of Mr. Howard W. Post, a Fellow of the Institute.

Attention was called to the form of the advertisement of "Velo-Derma" and the matter was referred to the Committee on Ethics, with the request that they report to the next meeting of the Council.

The Secretary read a letter from Mr. W. J. Baĕza, secretary of the Volunteer Workers Committee, with the resolutions adopted at the mass meeting held on March 4, 1932, sponsored by nine chemical and engineering societies to consider the unemployment of chemists in the metropolitan district.

On motion made and seconded it was

RESOLVED, That the American Institute of Chemists accept the resolution for the organization of a Central Committee, as outlined therein, and that Mr. Frank G. Breyer and Mr. W. J. Baĕza be appointed as representatives of the American Institute of Chemists to that committee.

Upon motion made and seconded it was

RESOLVED, That the American Institute of Chemists appropriate $500

through the New York City Chapter for the above-mentioned Central Committee, subject to the call of that committee.

The Treasurer's report was accepted and filed.

A Finance Committee, composed of Messrs. Sachs, Zons, and Gordy, was appointed to devise a routine system for handling the financial affairs of the Institute.

The President was empowered to appoint a committee to cooperate with him in making a census of our membership. Messrs. Sachs and Neiman were appointed to this committee.

Dr. Knight reported for the committee on ethics. After considerable discussion the suggested changes to Section 6 of the Code of Ethics were referred back to the committee for further consideration.

Upon motion made and seconded it was

RESOLVED, That one of The American Institute of Chemists leaflets be enclosed with each report of the Committee on Education, and that copies be forwarded to the secretary of each chapter, and to the Unemployment Committee.

Upon motion made and seconded it was

RESOLVED, to renew the lease upon the present offices of the American Institute of Chemists.

The Secretary reported upon the present membership.

There being no further business, adjournment was taken.

HOWARD S. NEIMAN, *Secretary*

Pennsylvania Chapter

Instead of the regular monthly meeting, the Pennsylvania Chapter took a trip through the University of Pennsylvania Museum in Philadelphia on Saturday afternoon, March 5th. Miss Craighead of the museum staff acted as guide and furnished the group with a clear, witty description of the various objects viewed.

The finds of the recent expedition to Mesopotamia were the first to be looked over. Among these objects were the gold and silver ornaments of the time of Abraham in Ur of the Chaldees. The Chinese section was visited and also the Mayan room. Miss Craighead then took the group through the Egyptian department, which has a very large number of interesting antiques. The tour was completed with a trip through the Greek and Roman galleries.

FRANKLIN D. JONES, *Chairman*

New York Chapter

The March meeting of the New York Chapter was omitted in order to permit the members to attend the mass meeting of metropolitan chemists and chemical engineers, mention of which was made in the March issue of *The* CHEMIST.

Among the speakers were the following members of the Institute: Charles H. Herty, Edward R. Weidlein, D. D. Jackson. Their speeches, as well as that of J. P. H. Perry, of the Engineering Societies, are reported in this issue of *The* CHEMIST.

New Members

The following members were elected at the meeting of the National Council held on March 10, 1932:

FELLOW

HEINRICH MEISTER, *Chemist*, Wallerstein Company, Inc., 125 Lake Avenue, Mariners' Harbor, Staten Island, N. Y.

ASSOCIATE

HOWELL DAVIS SPEARS, *Chemist*, Kentucky Experiment Station, Lexington, Kentucky.

JUNIORS

EDGAR DARE BOLINGER, *Laboratory Assistant*, Juniata College, Huntingdon, Pa.

SEYMOUR S. LEIKIND, *Fellow*, Brooklyn College, 80 Willoughby Street, Brooklyn, N. Y.

JULIAN SAPHIER, *Student*, College of the City of New York, New York, N. Y.

Applications for Membership

The following applications for membership have been received:

FELLOWS

HARRY ARNOLD BAKER, *Professor and Head of Department of Physics*, John Tarleton Agricultural College, Stephenville, Texas.

SAMUEL HENRI CON'E, *Director of Research*, Paint Department, Sinclair Refining Company, 45 Nassau Street, New York, N. Y.

HARRY GUSTAVE LINDWALL, Assistant Professor of Chemistry, New York University, University Heights, New York, N. Y.

CHARLES WALLACE MACFARLANE, Laboratory Owner, Oaks, Montgomery County, Pa.

ASSOCIATE

CHARLESANNA B. COLES, *Graduate Student*, 6742 Irving Avenue, Merchantville, N. J.

JUNIOR

MILTON KADISHOWITZ, *Student*, 538 Essex Street, Brooklyn, N. Y.

NEWS

Foster D. Snell addressed the class in industrial administration at C. C. N. Y. on March 15th. His subject was "The Relation of the Consulting Chemist to Business."

Food Group

The Society of Chemical Industry has formed a food group among the members of the society. For the present, at least, there is no additional subscription beyond the usual dues for membership in the society. Further information will be furnished on request to Foster D. Snell, Honorary Secretary of the American Section, 130 Clinton St., Brooklyn, N. Y.

The firm of Sheldon, Morse, Hutchins, and Easton, which was recently formed to handle industrial marketing and the economic problems connected with scientific industrial research, has moved its offices to the Graybar Building, 420 Lexington Avenue, New York City.

Chemist in Moscow

Hilmeyer Cohen is engaged in research at the Central Institute of the Sugar Industry in Moscow, Russia, under the direction of Professor Tischenko.

Dr. Cohen writes that life in Moscow is at present rather hard, but extremely interesting. For three months he had no place to sleep, but was finally gratified to receive from the Institute a nice warm room, a most highly prized possession in Moscow.

Textile Fellowships

The Textile Foundation will award twenty-four fellowships for research in the fields of chemistry, physics, biology, and engineering. Senior fellowships, open to Ph.D.'s, will pay $2000 to $2200 to unmarried candidates; $2400 to $2700 to married candidates. Junior fellowships will pay $1000 to unmarried candidates; $1200 to married men. Scholarships, open to college seniors, will amount to $750. Tuition and laboratory fees will be paid by the Foundation.

Applications should be made to Edward T. Pickard, Secretary of the Textile Foundation, Commerce Building, Washington, D. C.

W. H. Dickhart, formerly with the Bureau of Chemistry, New York Produce Exchange, has entered consulting practice in the oil, fat, and wax industries. His laboratory is at 189 Franklin Street, New York, N. Y.

Frank H. Moser has accepted a position as research chemist with the National Aniline and Chemical Company, Buffalo, N. Y.

George M. Norman has been appointed manager of the development department of the Hercules Powder Company.

J. Enrique Zanetti, professor of chemistry at Columbia, will make a survey of the Chilean nitrate industry for the Chemical Foundation and synthetic nitrate interests in the United States.

Nichols Medal

James B. Conant, professor of organic chemistry at Harvard, received the Nichols medal on March 11th at a joint meeting of the American Chemical Society, Society of Chemical Industry, Electrochemical Society, and Société de Chimie Industrielle.

Dr. Conant delivered the main address of the evening on "The Chemistry of Chlorophyll," the chemical study for which he was awarded the medal.

The medal was presented by Arthur E. Hill, F.A.I.C. Walter S. Landis, chairman of the New York Section of the American Chemical Society, presided.

Charles Barban, F.A.I.C., is on a trip discussing with various legislative leaders throughout the country the possibility of legislative action on cosmetics.

Guggenheim fellowships have been awarded to the following: Oliver R. Wulf of the Bureau of Chemistry and Soils; Herbert O. Calvery of the University of Michigan; William T. Richards of Princeton University.

The Priestley lectures at Penn State will be given this year by **Victor K. La Mer.**

L. C. Case presented a paper on "The Application of Water Analyses" at a meeting of the Society of Economic Geologists at Tulsa.

Clarence K. Simon, formerly president and general manager of Dye Products & Chemical Company, and lately connected with Calco Chemical Company, is now engaged in consulting chemical engineering practice.

Charles S. Glickman, North Carolina graduate, has joined the laboratory staff of the Glyco Products, Incorporated, Brooklyn. He will devote most of his time to special emulsion work on leather, food, cosmetics, textiles, rubber, and paint.

Protected Metal

According to a recent research report by Dr. A. W. Coffman, a new protected metal has been carried through the laboratory stage of development at the

Mellon Institute of Industrial Research.

The new invention, known as "Robertson bonded metal," consists of a laminated material in which felts are cemented onto steel with heat and pressure, using metals as adhesive. The outer surface is saturated with paint, lacquer, or resin films to give added protection and an attractive appearance.

The new material can be subjected to shearing, bending, corrugating, rolling, and mild drawing without destroying adhesion between felt and steel. An asbestos felt with a fire-proof saturant gives a fire-proof material with valuable insulating qualities.

The chief field of application of the new metal is in the building field, in the manufacture of paneling, pipe line protection, novelties, etc.

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